INSTRUCTION MANUAL

3900XP/3-3-C

California INSTRUMENTS

MP MASTER

MA28017

Invertron® AC POWER EQUIPMENT

An affiliate of Amstar CORPORATION

California Instruments

A Division of Amstar Technical Products Company, Inc

5150 Convoy Street
San Diego, CA 92111-1266

(619) 279-8620
Telex 695047

California INSTRUMENTS

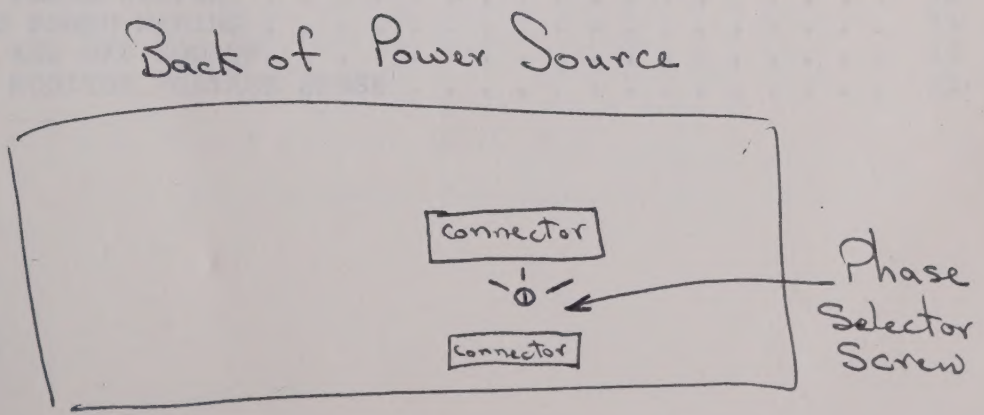
Original
September 1985

Copyright © 1985 by California Instruments. All rights reserved

INSTRUCTION MANUAL

3900XP/3-3-C

Invertron®



XP SERIES MANUAL

TABLE OF CONTENTS

Section			Page
I	GENERAL DESCRIPTION		
	1.1	INTRODUCTION.	8
	1.2	SPECIFICATIONS.	8
	1.3	GENERAL DESCRIPTION	14
	1.4	ACCESSORY EQUIPMENT	14
		1.4.1 Rack Slides.	14
		1.4.2 Oscillators and Power Controllers.	14
		1.4.3 Instrument Modules	15
		1.4.3.1 IMA	15
		1.4.3.2 IMB1.	16
		1.4.3.3 IMC1.	16
II	INSTALLATION AND OPERATION		
	2.1	UNPACKING	22
	2.2	POWER REQUIREMENTS.	22
		2.2.1 AC Line Voltage Input Connections.	22
		2.2.2 Line Frequency Operating Range	22
		2.2.3 Normal Input Power	22
	2.3	CIRCUIT BREAKER REQUIREMENTS.	24
	2.4	OUTPUT VOLTAGE RANGES	27
	2.5	FRONT PANEL CONTROLS.	27
		2.5.1 Circuit Breaker.	27
		2.5.2 Additional Controls.	27
	2.6	ACCEPTANCE TEST PROCEDURE	28
		2.6.1 Initial Set-up	28
		2.6.2 Power On	28
		2.6.3 Set-up For Load/Overload Test.	28
		2.6.4 Load Test.	31
		2.6.5 Overload Test.	31
		2.6.6 Extended Testing	31
	2.7	MECHANICAL INSTALLATION	32
	2.8	INPUT POWER WIRING.	32
	2.9	OUTPUT POWER WIRING	33
	2.10	DELTA AND WYE HOOKUP.	33
	2.11	POWER MONITOR VOLTAGE SENSE	33

XP SERIES

TABLE OF CONTENTS

Section			Page
III	THEORY OF OPERATION		
	3.1	GENERAL	39
	3.2	DETAILED CIRCUIT DESCRIPTION.	40
		3.2.1 Input Filter	40
		3.2.2 Preamplifier (G1, G2).	40
		3.2.3 Power Amplifier (G3)	40
		3.2.4 Output Range Selection	41
		3.2.5 Positive Voltage Feedback.	48
		3.2.6 Power Supply Fault Condition	48
		3.2.7 Current Limit Programming.	48
		3.2.8 Overload and Overpower Protection.	48
		3.2.9 Temperature Sense Circuit.	49
		3.2.10 Integrator	50
		3.2.11 Main Power Supply.	50
		3.2.12 Auxiliary Power Supply	51
IV	CALIBRATION PROCEDURE		
	4.1	GENERAL	53
	4.2	TEST EQUIPMENT REQUIRED	54
	4.3	INITIAL ADJUSTMENTS	64
	4.4	MEASURE POWER SUPPLY VOLTAGES	64
	4.5	TEMPERATURE LIMIT TEST.	64
	4.6	POWER LIMIT TEST.	71
	4.7	MAXIMUM LOAD INPUT POWER TEST	71
	4.8	LINE REGULATION TEST.	73
	4.9	LOAD REGULATION ADJUSTMENT.	73
	4.10	HARMONIC DISTORTION TEST	74
	4.11	FREQUENCY RESPONSE TEST	75
	4.12	AC NOISE LEVEL TEST	75
		4.12.1 Peak-to-Peak Measurements	75
		4.12.2 RMS Measurements.	76
	4.13	0.7 LAGGING POWER FACTOR TEST	76
	4.14	0.7 LEADING POWER FACTOR TEST	77
	4.15	PROGRAMMABLE CURRENT LIMIT TEST	86
		4.15.1 Test Current Limit.	86
		4.15.2 Test Other Voltage Ranges and Frequencies	87
	4.16	OVERLOAD TEST	87
	4.17	24 HOUR AMPLITUDE STABILITY TEST.	88

XP SERIES

TABLE OF CONTENTS

Section			Page
V	MAINTENANCE AND TROUBLESHOOTING		
	5.1	GENERAL	95
	5.2	TROUBLESHOOTING	95
		5.2.1 External Checks	95
		5.2.2 Check DC Power Supply	96
		5.2.3 Check Power Amplifier Output	96
		5.2.4 Check Preamplifier Output	96
		5.2.5 Check Fault Circuits	96
		5.2.5.1 Temperature Sense Circuit	96
		5.2.5.2 Overload Circuit	96
		5.2.5.3 Overpower Circuit	97
		5.2.6 Check Plug-in Oscillator/Power Controller	97
		5.2.7 Check Instrument Module	97
VI	CIRCUIT DIAGRAMS		
	6.1	GENERAL	98
	6.2	REFERENCE DESIGNATIONS	98
VII	REPLACEABLE PARTS		
	7.1	GENERAL	99
	7.2	ORDERING INFORMATION	99
	7.3	COMPUTER GENERATED PARTS LISTS	100
		7.3.1 Sequence No.	100
		7.3.2 Component Item No.	100
		7.3.3 Description Truncated	100
		7.3.4 Engineering Drawing Number	100
		7.3.5 Vendor	100
		7.3.6 Quantity	100

LIST OF ILLUSTRATIONS

Figure		Page
1-1-1	Model 1301XP Power Source Outline Drawing	17
1-1-2	Model 971XP Power Source Outline Drawing.	18
1-1-3	Model 651XP Power Source Outline Drawing.	19
1-1-4	Model 321XP Power Source Outline Drawing.	20
2-1	Voltage Selector Board Jumper Connections for Various AC Input Line Voltages.	25
2-2	XP Series DELTA Hookup.	37
2-3	XP Series WYE Hookup.	38
3-1	Block Diagram for XP Series Preamplifier.	46
3-2	Block Diagram for XP Series Power Supply Regulator	47
4-1	XP Series DC Power Supply/Preamplifier Test Points. .	65
4-2	XP Series AC Input Power Connection Diagram	68
4-3	Location of Internal Adjustments for XP Series Power Source.	69
4-4	XP Series Test Circuit Connection Diagram	70
4-5A	1301XP Load Circuit for TA=25 degrees C 0.7 Lagging Power Factor at 400 Hz.	78
4-5B	1301XP Load Circuit for TA=55 degrees C 0.7 Lagging Power Factor at 400 Hz.	78
4-6A	971XP Load Circuit for TA=25 degrees C 0.7 Lagging Power Factor at 400 Hz.	79
4-6B	971XP Load Circuit for TA=55 degrees C 0.7 Lagging Power Factor at 400 Hz.	79
4-7A	651XP Load Circuit for TA=25 degrees C 0.7 Lagging Power Factor at 400 Hz.	80
4-7B	651XP Load Circuit for TA=55 degrees C 0.7 Lagging Power Factor at 400 Hz.	80
4-8A	321XP Load Circuit for TA=25 degrees C 0.7 Lagging Power Factor at 400 Hz.	81
4-8B	321XP Load Circuit for TA=55 degrees C 0.7 Lagging Power Factor at 400 Hz.	81
4-9A	1301XP Load Circuit for TA=25 degrees C 0.7 Leading Power Factor at 400 Hz.	82
4-9B	1301XP Load Circuit for TA=55 degrees C 0.7 Leading Power Factor at 400 Hz.	82
4-10A	971XP Load Circuit for TA=25 degrees C 0.7 Leading Power Factor at 400 Hz.	83
4-10B	971XP Load Circuit for TA=55 degrees C 0.7 Leading Power Factor at 400 Hz.	83
4-11A	651XP Load Circuit for TA=25 degrees C 0.7 Leading Power Factor at 400 Hz.	84

LIST OF ILLUSTRATIONS

Figure		Page
4-11B	651XP Load Circuit for TA=55 degrees C 0.7 Leading Power Factor at 400 Hz.	84
4-12A	321XP Load Circuit for TA=25 degrees C 0.7 Leading Power Factor at 400 Hz.	85
4-12B	321XP Load Circuit for TA=55 degrees C 0.7 Leading Power Factor at 400 Hz.	85

LIST OF TABLES

Table		Page
1-1	Specifications XP Series Power Sources.	8
2-1	Input Power for Different XP Series Power Sources . . .	23
2-2	XP Series Circuit Breakers.	24
2-3	Power Transformer Connections for Various AC Input Line Voltages.	26
2-4-1	Output Voltage and Load Values for 1301XP	29
2-4-2	Output Voltage and Load Values for 971XP.	29
2-4-3	Output Voltage and Load Values for 651XP.	30
2-4-4	Output Voltage and Load Values for 351XP.	30
2-5	Input Power for XP Series Power Sources at No Load and Midline Voltage	32
2-6-1	Output Wiring for 1301XP.	34
2-6-2	Output Wiring for 971XP	34
2-6-3	Output Wiring for 651XP	35
2-6-4	Output Wiring for 321XP	35
2-7	Multi-Phase Output VA Values.	36
3-1	Circuit Board Listing for 1301XP.	42
3-2	Circuit Board Listing for 971XP	43
3-3	Circuit Board Listing for 651XP	44
3-4	Circuit Board Listing for 321XP	45
4-1	Calibration Procedure Listing	53
4-2	Adjustable Component Listing.	54
4-3-1A	Calibration Output Voltages, Load Settings and Tolerances for 1301XP Power Source at full rated output.	56
4-3-1B	Calibration Output Voltages, Load Settings and Tolerances for 1301XP Power Source at 78% rated output.	57

LIST OF TABLES (CONT.)

Table		Page
4-3-2A	Calibration Output Voltages, Load Settings and Tolerances for 971XP Power Source at full rated output.	58
4-3-2B	Calibration Output Voltages, Load Settings and Tolerances for 971XP Power Source at 78% rated output.	59
4-3-3A	Calibration Output Voltages, Load Settings and Tolerances for 651XP Power Source at full rated output.	60
4-3-3B	Calibration Output Voltages, Load Settings and Tolerances for 651XP Power Source at 78% rated output.	61
4-3-4A	Calibration Output Voltages, Load Settings and Tolerances for 321XP Power Source at full rated output.	62
4-3-4B	Calibration Output Voltages, Load Settings and Tolerances for 321XP Power Source at 78% rated output.	63
4-4	DC Power Supply/Preamplifier Test Points.	66
4-5	Input Power at High Line and Full Rated Output.	72
4-6	Capacitor Values for Zero Power Factor at f=1 KHz . . .	88
4-7-1	1301XP Load Values for Rated Output and Overload Conditions	89
4-7-2	971XP Load Values for Rated Output and Overload Conditons.	89
4-7-3	651XP Load Values for Rated Output and Overload Conditons.	90
4-7-4	321XP Load Values for Rated Output and Overload Conditons.	90
4-8-1	1301XP Current Limit Values and Current Limit Programmed DC Voltages.	91
4-8-2	971XP Current Limit Values and Current Limit Programmed DC Voltages.	91
4-8-3	651XP Current Limit Values and Current Limit Programmed DC Voltages.	92
4-8-4	321XP Current Limit Values and Current Limit Programmed DC Voltages.	92
4-9	Load Values for 115 VAC Output.	93

1301XP
LIST OF DRAWINGS

ASSEMBLY REFERENCE DESIGNATORS	DRAWING NUMBER	TITLE
	4000-902	Outline Drawing
	4000-409	Top Assembly
	4000-404	Front Panel Assembly
	4000-406	Rear Panel Assembly
A1	4000-713	PC Assembly, Mother Board
A4, A5, A6	4000-401	Heatsink Assembly, Power Amplifier
	4000-088	Schematic, Top Assembly
A2	4000-700	PC Assembly, Filter
	4000-081	Schematic, Filter
A3	4000-710	PC Assembly, Preamplifier
	4000-080	Schematic, Preamplifier
	4000-709	PC Assembly, Power Amplifier
	4000-083	Schematic, Power Amplifier
	4000-715	PC Assembly, Phase Selector
	4000-086	Schematic, Phase Selector

SECTION I

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, operation, and maintenance of the California Instruments XP Series AC Power Sources.

1.2 SPECIFICATIONS

Table 1-1 contains the operating specifications for XP Series power sources. All specifications are tested in accordance with standard California Instruments test procedures and apply with a stable, low distortion input signal as generated by any XP-series oscillator/power controller.

TABLE 1-1 SPECIFICATIONS

XP-SERIES POWER SOURCE

POWER OUTPUT: at TA=25 degrees C	1300 VA, 975 VA, 650 VA and 325 VA at 105 volts rms on the 0-135 volts range at 0.7 power factor. 1300 VA, 975 VA, 650 VA and 325 VA at 210 volts rms on the 0-270 volts range at 0.7 power factor.
POWER OUTPUT: at TA=55 degrees C	1000 VA, 750 VA, 500 VA and 250 VA at 105 volts rms on the 0-135 volts range at 0.7 power factor. 1000 VA, 750 VA, 500 VA and 250 VA at 210 volts rms on the 0-270 volts range at 0.7 power factor. In each of the above conditions, load current remains constant for 78% to 100% of rated output voltage.
OUTPUT VOLTAGE RANGES:	0-135 volts rms 0-270 volts rms

OPTIONAL:	0-67.5 volts rms 0-135 volts rms Voltage range selectable by front panel range key or via IEEE-488 bus when used with the XP-series programmable oscillators/AC power controllers.
LOAD REGULATION:	±1% over the range from 45 Hz to 5 KHz when tested at unity power factor.
TOTAL HARMONIC DISTORTION:	Less than 0.5% from 45 Hz to 5 KHz.
LINE REGULATION:	±0.1% of full output for a ±10% line change.
AMPLITUDE STABILITY:	±0.25% for 24 hours at constant line, load and ambient temperature.
FULL POWER FREQUENCY RANGE:	45 Hz to 5 KHz (Optional 15 Hz at derated power) 33% Voltage and 30% power.
FREQUENCY RESPONSE:	±0.5dB 45 Hz to 5 KHz.
EFFICIENCY:	56% at full power out at 135V at 1.0 power factor.
AC NOISE LEVEL:	70dB rms below full rms output with shorted input. 60dB below full peak-to-peak output with shorted input. 60dB below full rms output at full rated power output. 50dB below full peak-to-peak output at full rated power output.
OVERLOAD/SHORT CIRCUIT OVERPOWER PROTECTION:	A fault resulting from overloading, short circuit or overpower condition will cause a "OVERLOAD" indicator to illuminate on the front panel. The output voltage will then be clipped on the peaks or drop to zero depending on the type of overload.

OVERTEMPERATURE PROTECTION:	Thermal overload resulting from excessive heatsink temperature will cause a "OVERTEMP" indicator to illuminate on front panel and the output voltage will drop to zero.
AMPLIFIER DRIVE (normally obtained from plug-in oscillator through Instrument Module)	5 volts rms (typical) produces full scale output.
OPTION:	Programmable current limit is available in conjunction with an IMC Instrument Module. Current programming and limiting is in peak amperes. The accuracy is ±5% for the range of 10% to 100% of rated output.
AC MAINS INPUT:	103 to 135 VAC or 207 to 270 VAC single phase. The input transformer can be rewired for 90 to 127 VAC or 180 to 253 VAC single phase.
AC MAINS FREQUENCY:	48 Hz to 65 Hz.
OPERATING TEMPERATURE RANGE:	0 to 55 degrees C.
STORAGE TEMPERATURE RANGE:	-25 degrees to 85 degrees C.
ACOUSTIC NOISE:	Less than 60 dB maximum when mounted in equipment rack measure three feet from front center, "A" weighted scale.
FRONT PANEL METER:	Monitors output voltage or load current. Resolution is 1 volt or 0.1 ampere. With "kiloWatts" option resolution is 10 watts.
FRONT PANEL INDICATORS:	"POWER ON" "RANGE" "OVERLOAD" "OVERTEMP"

FRONT PANEL CONTROLS:	
Amplifier:	Main Circuit Breaker
Instrument Module:	Range; IMB, IMC Volts; IMB, IMC Amp: IMB, IMC KiloWatt; IMC
INPUT/OUTPUT CONNECTORS:	Input provided on rear mounted terminal block, Kulka 9-85-3.
	Output provided on rear mounted terminal block, Kulka 9-85-3.
	Servo Sense inputs for individual phases provided on Amp cap 1-480701-0 w/Amp Socket Contact 350689-1. The mating connector is Amp plug 1-480700-0 w/Amp contact pin 350547-1.
	Interfacing in a multi-phase system is provided with the Belden cable assembly 4000-427. The power source connector is Amp 552118-1. The mating connector is Amphenol 57-20500-15.
	Oscillator/Control signals are provided on rear mounted GPIB connector 3M 3549-1000 as an option.
DIMENSIONS: (in inches)	1301XP - 19W - 22D - 5.25H 971XP - 19W - 22D - 5.25H 651XP - 19W - 22D - 7.00H 321XP - 19W - 22D - 7.00H
NET WEIGHT:	1301XP 105 Pounds 971XP 90 Pounds 651XP 77 Pounds 321XP 60 Pounds
SHIPPING WEIGHT:	1301XP 135 Pounds 971XP 120 Pounds 651XP 107 Pounds 321XP 90 Pounds
FRONT PANEL FINISH:	Gray, 26440 per federal standard 595 with black silk-screened lettering.

XP SERIES AC POWER SOURCE

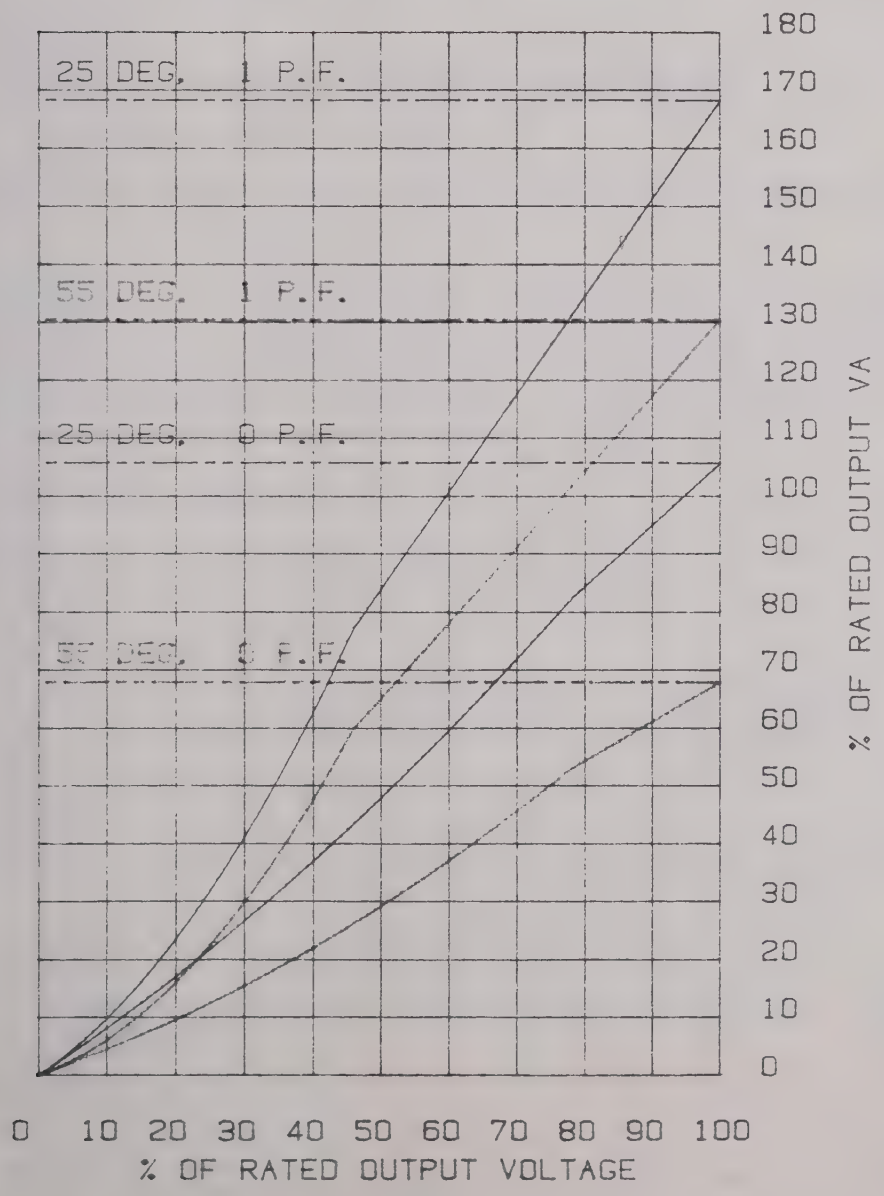
OUTPUT POWER CURVES

MODEL 321XP, 100% RATED POWER IS 250VA

MODEL 651XP, 100% RATED POWER IS 500VA

MODEL 871XP, 100% RATED POWER IS 750VA

MODEL 1301XP, 100% RATED POWER IS 1000VA



THIS PAGE LEFT PURPOSELY BLANK.

1.3 GENERAL DESCRIPTION

The California Instruments XP Series AC Power Amplifiers are solid state, high performance, low distortion power sources that provide up to 1300 VA output when used with the proper plug-in oscillator/power controller. The XP Series AC Power Sources are illustrated in Figures 1-1-1 thru 1-1-4. Full power output is available in two different voltage ranges and over the frequency range from 45 Hz to 5 KHz.

1) 105 to 135 volts rms for normal single phase 115 volt applications.

2) 210 to 270 volts rms for normal single phase 230 volt applications.

Optional:

3) 52.5 to 67.5 volts rms for single phase low AC voltage applications.

4) 105 to 135 volts rms for normal single phase 115 volt applications.

For two-phase and three-phase operation, at least two power amplifiers must be combined together with the applicable multi-phase oscillator/power controller. For available output VA from two power sources in two-phase configuration, three-phase open DELTA configuration, and three power sources in three-phase WYE configuration, refer to Table 2-5.

1.4 ACCESSORY EQUIPMENT

The following accessories are available for use with the California Instruments XP Series AC Power Sources.

1.4.1 Rack Slides

Zero Manufacturing Company Model CTK-118 rack slides may be bolted directly to the sides of the unit, if required.

1.4.2 Oscillators and Power Controllers

The 900 Series oscillators include three separate models. These are:

1) 910XP oscillator with fixed frequency.

2) 913XP oscillator with three separate operation frequencies.

3) 920XP oscillator.

Additional power controllers and oscillators may be used with the XP Series Power sources. They are briefly described in the following paragraphs.

The 948XP AC Power Controller is a microprocessor controlled plug-in module which interfaces to the IEEE-488 GPIB. Programming and local control of the power controller/power source combination are accomplished via the front panel keyboard of the power controller.

The 949XP AC Power Controller is a self-contained, microprocessor controlled plug-in module that allows independent programming of amplitude, phase angle, current limits and frequency via the IEEE-488 GPIB.

The 850XP Oscillator is a decade dialing, digitally synthesized and crystal controlled plug-in unit.

1.4.3 Instrument Modules

The Instrument Module is a plug-in unit designed for use with the XP Series AC Power Sources. The front panel of the module contains a digital LED display that reads out Volts, Amps or kiloWatts. Additionally, the front panel contains a separate overtemperature LED and a separate overload indicator LED. The range key located on the front panel is used to change the output range of the power source. Output range may also be remotely changed through the oscillator/AC power controller. Output voltage amplitude may be adjusted remotely through the oscillator/AC power controller.

Any one of three digital LED displays may be selected either locally using the front panel keys or remotely selected through the oscillator/AC power controller. In a three-phase system, the phase selection is done only remotely through the oscillator/AC power controller. The various versions of the Instrument Modules that are available are explained in the following paragraphs.

1.4.3.1 IMA

IMA has no display, no phase selection, and no function selection features. Overtemperature and overload indicator LEDs are available on the front panel. High range for the power source is indicated by an LED (illuminated when on Hi). Output voltage amplitude may be adjusted remotely through the oscillator/AC Power Controller. Output range of the power source may only be changed remotely through the AC power controller installed in the power source.

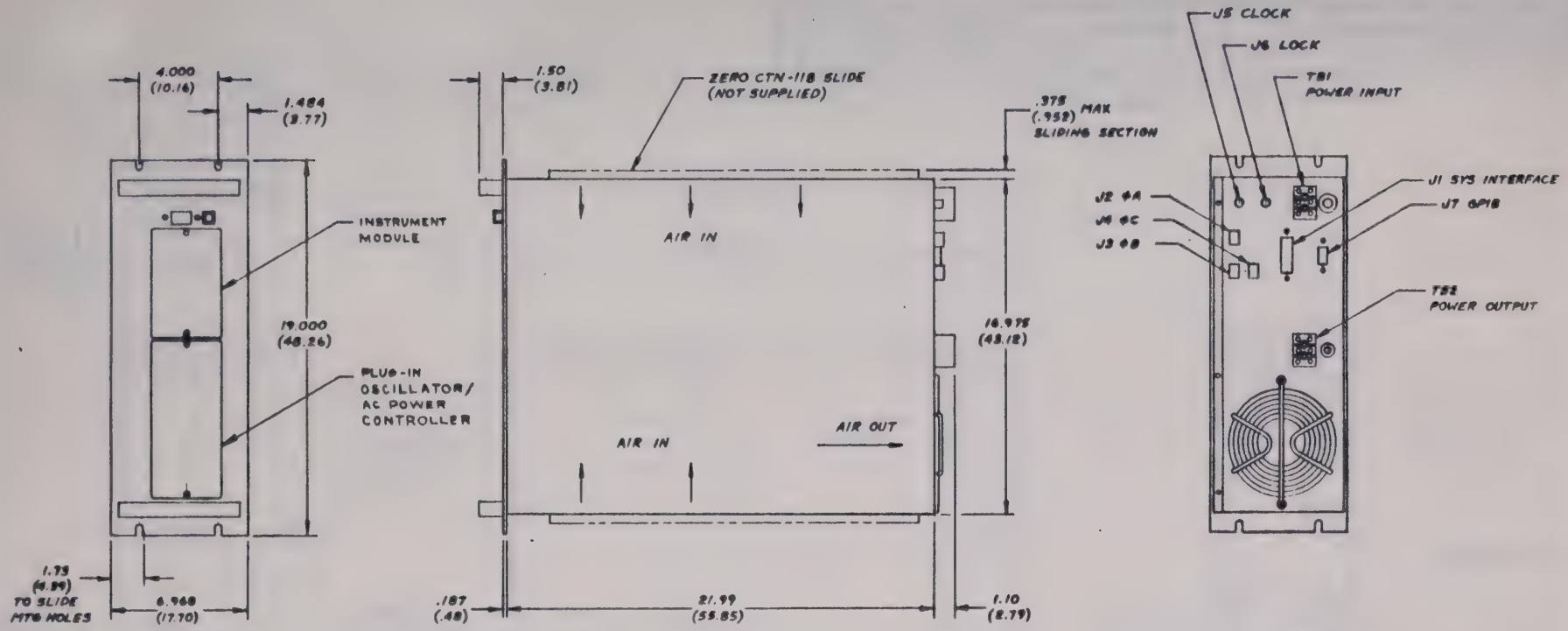
1.4.3.2 IMB1

IMB1 contains all the features described in paragraph 1.4.3 with the exception that it will display only Volts or Amps. It is the standard instrument module used in XP-Series AC power sources.

1.4.3.3 IMC1

IMC1 contains all the features described in paragraph 1.4.3.

REV	DESCRIPTION	DATE	APPROVED
A	ADDED DESIGNATING CALLOUTS TO FRONT VIEW	4/3/85	



FRONT VIEW

TOP VIEW

FIGURE 1-1-1

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE: OUTLINE DRAWING
1901XP

			ADDITIONAL APPROVALS
RELEASE	R. Lafgard	4/5/85	
PROJ ENG	J. ROUSE	3-22-85	
CHECK	EKWINE	3/28/85	
DESIGN			
DRAFT	AUROBERTO	14 MAR 85	

California Instruments
A DIVISION OF AMBTAR TECHNICAL PRODUCTS CO. INC SAN DIEGO CALIFORNIA

CONTRACT NO | CODE IDENT 16067

DWG NO 4000-902 | REV A

SCALE 1/4 | SHEET 1 OF 1

QTY REQD	USED ON	NEXT ASSY

2. DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS
1. FRONT PANEL DIMENSIONS PER E.I.A. STD RS-310

NOTES: (UNLESS OTHERWISE SPECIFIED)

4000-902 A

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADDED DESIGNATING CALLOUTS TO FRONT VIEW. 6/2/85 MC		

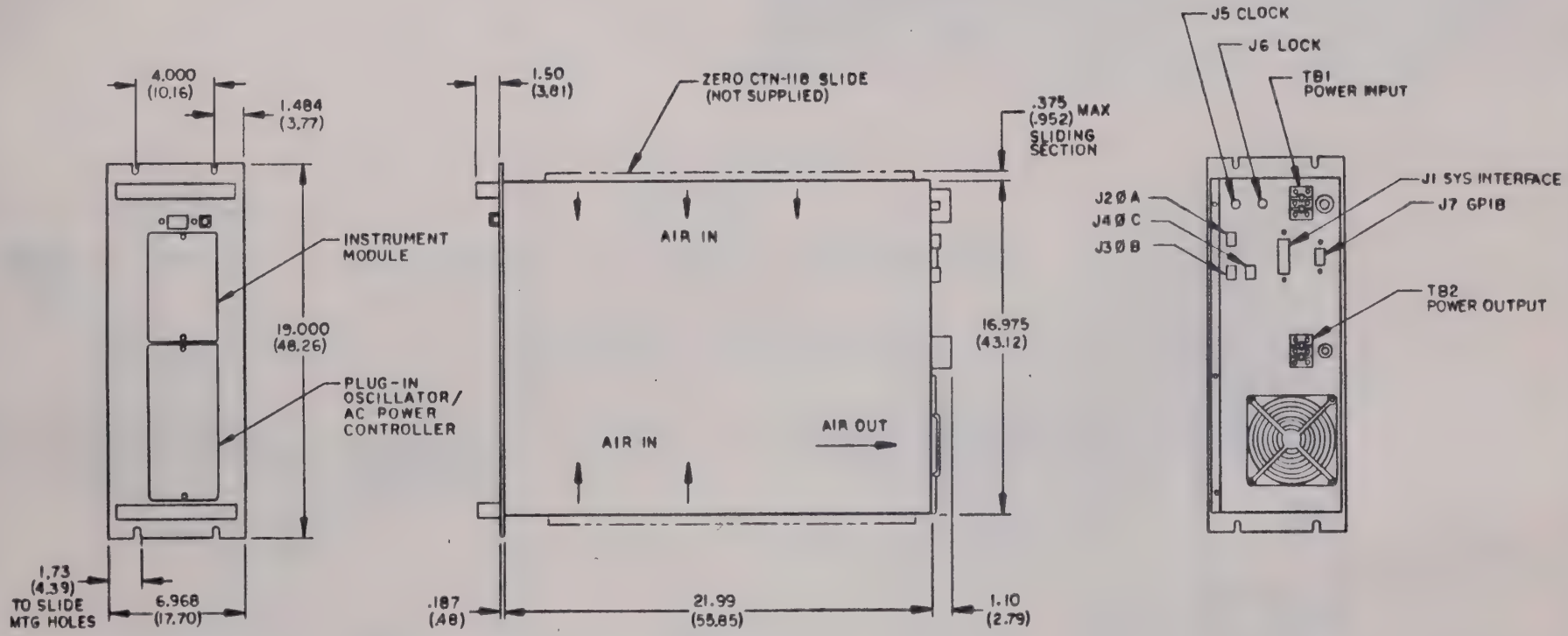


FIGURE 1-1-2

2. DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS.
1. FRONT PANEL DIMENSIONS PER E.I.A. STD RS-310.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

TITLE
OUTLINE DRAWING
971XP

California INSTRUMENTS
A DIVISION OF AMBAR TECHNICAL PRODUCTS CO. INC.
SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

			ADDITIONAL APPROVALS
RELEASE	R Ledgard	7/31/85	
PROJ ENG	J. Rouse	8/31/85	
CHECK	E.E. White	8/31/85	
DESIGN			
DRAFT	M. RICE		

CONTRACT NO
CUSTOMER 16067

DWG NO 4000-903
REV A

SCALE 1/4
SHEET 1 OF 1

QTY REQD	USED ON	NEXT ASSY

4000-903 A

REV	DESCRIPTION	DATE	APPROVED
A	ADDED DESIGNATING CALLOUTS TO FRONT VIEW	3/15/85	

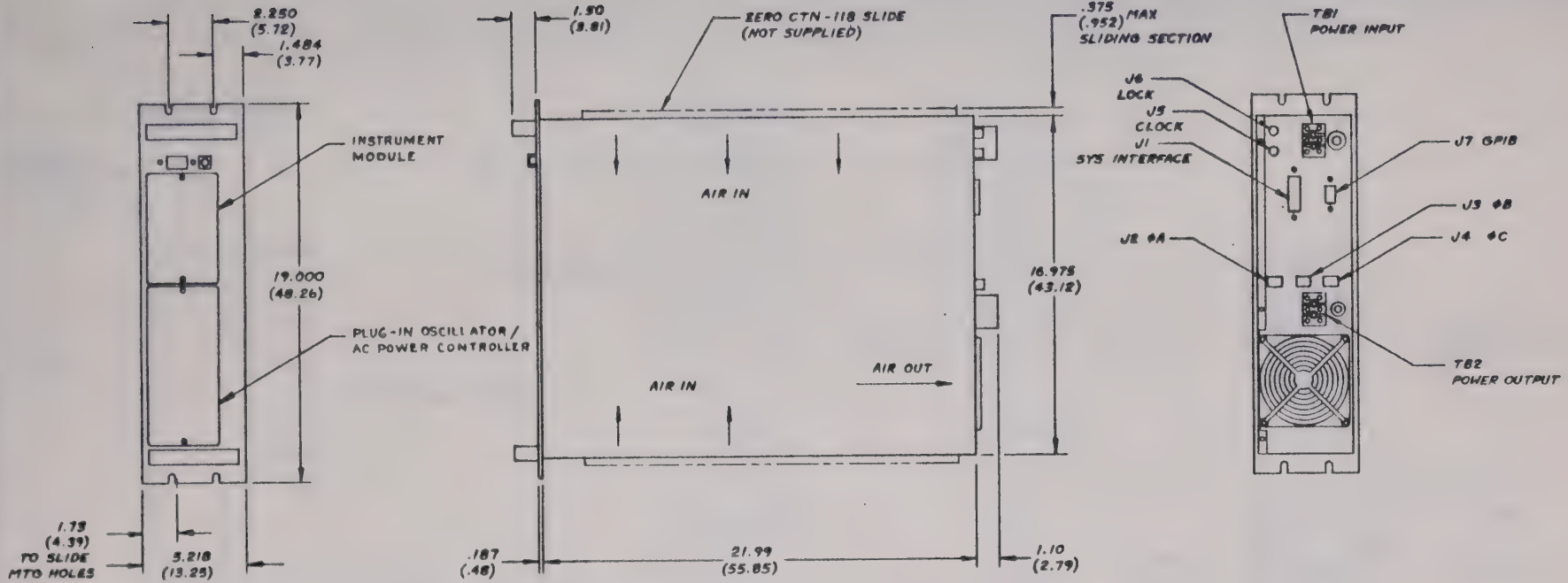


FIGURE 1-1-3

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

TITLE
OUTLINE DRAWING
321XP, 681XP

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO, CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

			ADDITIONAL APPROVALS
RELEASE	R Rodgers	3/15/85	
PROJ ENG	J. ROWE	3-22-85	
CHECK	E.R.W.M.E.	3/19/85	
DESIGN			
DRAFT	AJ ROBERTO	3/19/85	

FINISH

CONTRACT NO
CODE IDENT 16067
DWG NO 4000-901
REV A
SCALE 1/4
SHEET 1 OF 1

QTY REQD	USED ON	NEXT ASSY

NOTES: (UNLESS OTHERWISE SPECIFIED)

1. FRONT PANEL DIMENSIONS PER E.I.A. STD RS-910
2. DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS

4000-901 A

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADDED DESIGNATING CALLOUTS TO FRONT VIEW. 4/4/85		

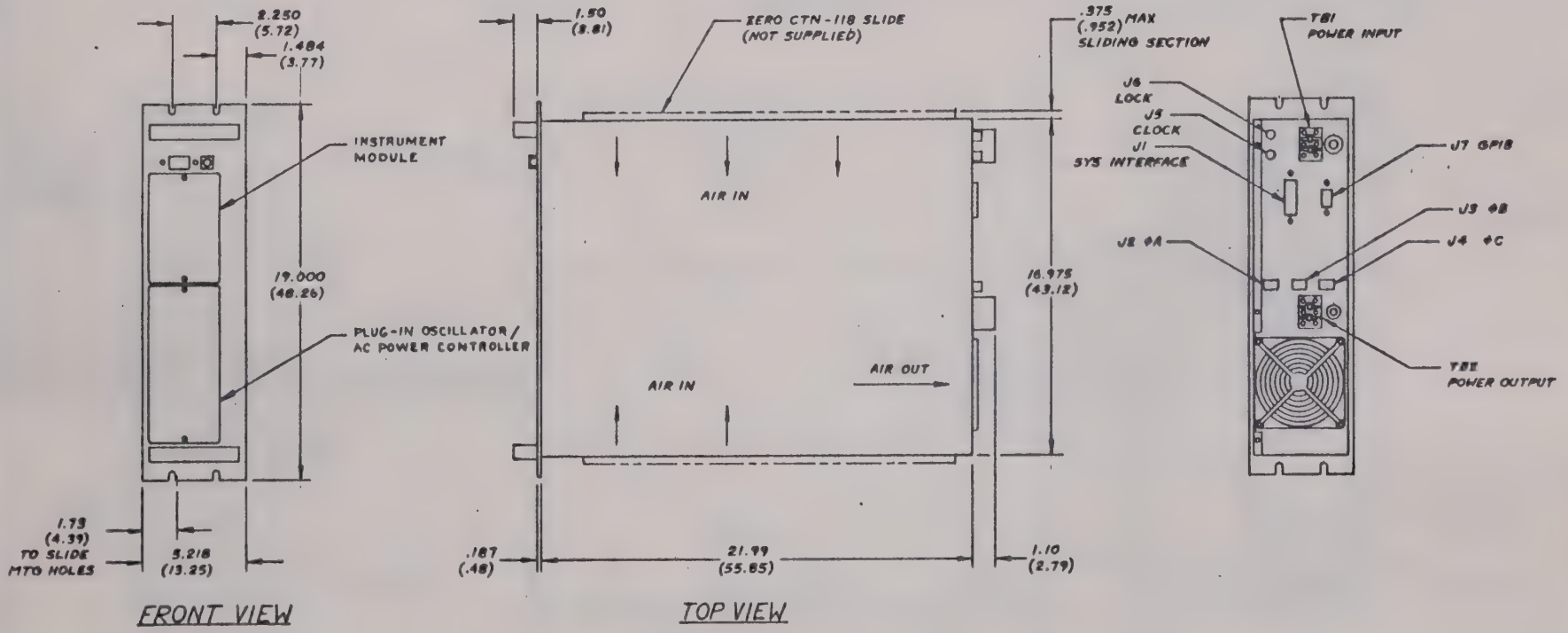


FIGURE 1-1-4

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES
TOLERANCES
XXX ± .010
.XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

TITLE
OUTLINE DRAWING
921XP, 681XP

California Instruments
A DIVISION OF AMETEK TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

			ADDITIONAL APPROVALS
RELEASE	A Bidgood	3/25/85	
PROJ ENG	J. ROWE	3/22/85	
CHECK	ERWIN	3/19/85	
DESIGN			

FINISH

CONTRACT NO
CODE IDENT 16067

DWG NO 4000-901
REV A

USED ON
NEXT ASSY

2. DIMENSIONS IN PARENTHESES ARE IN CENTIMETERS
1. FRONT PANEL DIMENSIONS PER E.I.A. STD RS-310

NOTES: (UNLESS OTHERWISE SPECIFIED)

WARNING

HIGH VOLTAGE (270 VAC)

Voltages up to 270 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

On contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with the primary power circuits, and the output circuits of the power source.

SECTION II

INSTALLATION AND OPERATION

2.1 UNPACKING

The California Instruments XP Series Power Source is shipped in a cardboard container with protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

Inspect the unit for any possible shipping damage immediately upon receipt. If damage is evident, notify the carrier. DO NOT return an instrument to the factory without prior approval. If the unit appears in good conditon, perform the following.

2.2 POWER REQUIREMENTS

2.2.1 AC Line Voltage Input Connections

The XP Series Power Sources have been designed to operate from any one of the following AC line voltages:

1) 90 to 127 volts
2) 103 to 135 volts
3) 180 to 253 volts
4) 207 to 270 volts

The input power transformer is normally wired at the factory to operate from the 115 volt AC line for the 321XP and 651XP power sources. The input power transformer is wired to operate from the 230 volt AC line for the 971XP and 1301XP power sources. Table 2-3 lists the primary power transformer connections for various AC input line voltages. Figure 2-2 shows the physical relationships of the primary power transformer connections.

2.2.2 Line Frequency Operating Range

The XP Series AC Power Source has been designed to operate over the line frequency range from 48 to 65 Hz.

2.2.3 Normal Input Power

The normal input power, at rated output, depending on line and load conditions is shown in Table 2-1 for different XP power sources.

TABLE 2-1
INPUT POWER FOR DIFFERENT XP SERIES POWER SOURCES

XP POWER SOURCE	INPUT POWER (WATTS) TA = 25 DEGREES C	TA = 55 DEGREES C
1301XP	185 to 3000	180 to 1950
971XP	90 to 2300	90 to 1420
651XP	75 to 1550	70 to 1010
321XP	40 to 770	40 to 500

2.3 CIRCUIT BREAKER REQUIREMENTS

The XP Series AC Power Sources use different circuit breakers in different units. Different circuit breakers are used in each unit for either low or high AC line voltages. Table 2-1 shows the correct circuit breaker application for each XP Series AC Power Source substitution of circuit breaker type or current rating may cause permanent damage to the unit.

TABLE 2-2 XP SERIES CIRCUIT BREAKERS

CIRCUIT BREAKER CURRENT RATING	AIRPAX PART NUMBER	XP POWER SOURCE USING CIRCUIT BREAKER
50 Amperes	APGX-66-1-65-503-H-21	1301XP at low AC line voltages.
40 Amperes	APGX-66-1-65-403-H-21	971XP at low AC line voltages.
35 Amperes	APGX-66-1-65-35-H-21	1301XP at high AC line voltages.
25 Amperes	UPGX-66-1-65-25-H-21	651XP at low AC line voltages. 971XP at high AC line voltages
18 Amperes	UPGX-66-1-65-183-H-21	651XP at high AC line voltages. 321XP at low AC line voltages.
10 Amperes	UPGX-66-1-65-103-H-21	321XP at high AC line voltages.

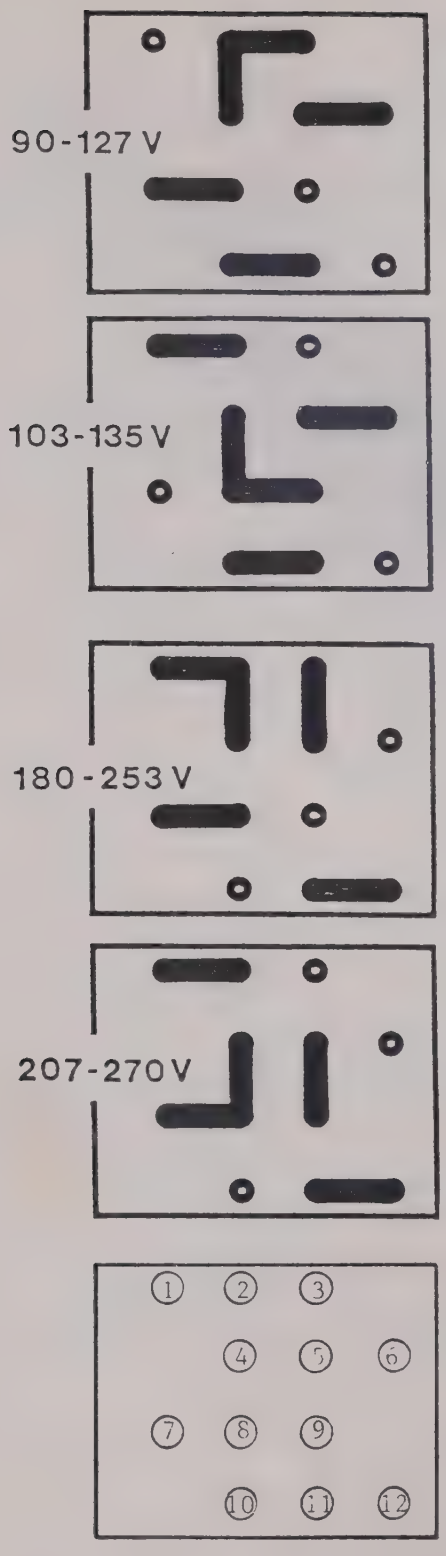


FIGURE 2-1
VOLTAGE SELECTOR BOARD JUMPER CONNECTIONS FOR VARIOUS AC INPUT LINE VOLTAGES

Table 2-3 Power Transformer Connections for Various AC Input Line Voltages

NOTE

Prior to reconnecting power transformer, T1, remove all existing jumpers from the voltage selector board.

INPUT VOLTAGE	OPERATING LINE VOLTAGE RANGE	VOLTAGE SELECTOR BOARD CONNECTIONS	FRONT PANEL CIRCUIT BREAKER VALUE
100-115 volts rms	90-127 volts rms.	jumper pins 2 and 3; jumper pins 2 and 4; jumper pins 5 and 6; jumper pins 7 and 8; jumper pins 10 and 11.	50 ampere for 1301XP; 40 ampere for 971XP; 25 ampere for 651XP; 18 ampere for 321XP
115 volts rms	103-135 volts rms	jumper pins 1 and 2; jumper pins 5 and 6; jumper pins 4 and 8; jumper pins 8 and 9; jumper pins 10 and 11.	50 ampere for 1301XP; 40 ampere for 971XP; 25 ampere for 651XP; 18 ampere for 321XP
208-220 volts rms	180-253 volts rms	jumper pins 1 and 2; jumper pins 2 and 4; jumper pins 3 and 5; jumper pins 7 and 8; jumper pins 11 and 12.	35 ampere for 1301XP; 25 ampere for 971XP; 18 ampere for 651XP; 10 ampere for 321XP
230-240 volts rms	207-270 volts rms	jumper pins 1 and 2; jumper pins 4 and 8; jumper pins 7 and 8; jumper pins 5 and 9; jumper pins 11 and 12.	35 ampere for 1301XP; 25 ampere for 971XP; 18 ampere for 651XP; 10 ampere for 321XP

TABLE 2-4-1

OUTPUT VOLTAGE AND LOAD VALUES FOR 1301XP

OUTPUT VOLTAGE RANGE	OUTPUT VOLTAGE	FULL POWER LOAD RESISTANCE		50 PERCENT POWER LOAD RESISTANCE	
		TA=25 C	TA=55 C	TA=25 C	TA=55 C
0-67.5 Volts	67.5 Volts rms	3.50	4.56	7.01	9.11
0-135 Volts	135 Volts rms	14.02	18.22	28.04	36.45
0-270 Volts	270 Volts rms	56.07	72.9	112.1	145.8

NOTE: All resistors are in ohms

TABLE 2-4-2

OUTPUT VOLTAGE AND LOAD VALUES FOR 971XP

OUTPUT VOLTAGE RANGE	OUTPUT VOLTAGE	FULL POWER LOAD RESISTANCE		50 PERCENT POWER LOAD RESISTANCE	
		TA=25 C	TA=55 C	TA=25 C	TA=55 C
0-67.5 Volts	67.5 Volts rms	4.7	6.07	9.35	12.15
0-135 Volts	135 Volts rms	18.7	24.3	37.4	48.6
0-270 Volts	270 Volts rms	74.77	97.2	149.5	194.4

NOTE: All resistors are in ohms

TABLE 2-4-3

OUTPUT VOLTAGE AND LOAD VALUES FOR 651XP

OUTPUT VOLTAGE RANGE	OUTPUT VOLTAGE	FULL POWER LOAD RESISTANCE		50 PERCENT POWER LOAD RESISTANCE	
		TA=25 C	TA=55 C	TA=25 C	TA=55 C
0-67.5 Volts	67.5 Volts rms	7	9.11	14	18.22
0-135 Volts	135 Volts rms	28.04	36.45	56.08	72.9
0-270 Volts	270 Volts rms	112.15	145.8	224.30	291.6

NOTE: All resistors are in ohms

TABLE 2-4-4

OUTPUT VOLTAGE AND LOAD VALUES FOR 321XP

OUTPUT VOLTAGE RANGE	OUTPUT VOLTAGE	FULL POWER LOAD RESISTANCE		50 PERCENT POWER LOAD RESISTANCE	
		TA=25 C	TA=55 C	TA=25 C	TA=55 C
0-67.5 Volts	67.5 Volts rms	14.02	18.22	28.04	36.45
0-135 Volts	135 Volts rms	56.08	72.9	112.15	145.8
0-270 Volts	270 Volts rms	224.3	291.6	448.61	583.2

NOTE: All resistors are in ohms

2.6.4 Load Test

1. Using the GAIN control on the oscillator/AC power controller, set the output voltage to the rated voltage of the unit as determined in Section 2.6.3 of this manual. Apply proper load per Tables 2-4-1 to 2-4-4.

2. Verify that the power line wattmeter reads less than the values in Table 2-5 at mid-line.

3. Verify that there is no peak clipping or excessive distortion of the sine wave output on the oscilloscope.

2.6.5 Overload Test

1. With the output still adjusted as determined in 2.6.4, place a resistor in parallel with the external load resistor to provide a 50% overload on the output of the power source; the value of this resistor is given in Tables 2-4-1 through 2-4-4 of this manual.

2. Verify that the signal on the oscilloscope exhibits significant clipping on both the positive or negative peaks indicating that the unit is in limiting condition.

3. Remove the 50 percent overload resistor. The output should return to normal.

4. Place a short circuit in parallel with the external load resistor and then remove the short circuit after a few seconds. The signal on the oscilloscope should go to zero and then return to normal when the short circuit is removed.

2.6.6 Extended Testing

1. Section 2.6.1 thru 2.6.5 may be repeated for any output frequency between 45 Hz and 5 KHz.

2. Section 2.6.1 thru 2.6.5 may be repeated on either of the output voltage ranges. See Tables 2-4-1 through 2-4-4 for voltage and load values.

3. The Calibration Procedure in Section IV of this manual should be used if more detailed evaluation of the XP Series power source is required.

TABLE 2-5
INPUT POWER FOR XP SERIES POWER SOURCES AT
NO LOAD CONDITIONS AND MIDLINE VOLTAGE

XP POWER SOURCE	INPUT POWER (WATTS) TA = 25 DEGREES C	TA = 55 DEGREES C
1301XP	2940	1930
971XP	2260	1405
651XP	1525	1005
321XP	760	550

2.7 MECHANICAL INSTALLATION

The XP Series AC Power Sources have been designed for rack mounting in a standard 19 inch rack. The unit should be supported from the bottom with a shelf-track or supported from the sides with a pair of rack slides (Zero Manufacturing type CTN-118 or equivalent).

The cooling fans on the rear of the unit must be free of any obstructions which would interfere with the flow of air. A 2.5 inch clearance should be maintained between the rear of the fans and the rear door of the mounting cabinet. Also, the air intake holes on the sides and rear of the power source must not be obstructed.

2.8 INPUT POWER WIRING

The XP Series Power Source will operate from single phase input voltages from 90 volts to 270 volts rms in four ranges as described in Section 2.2 of this manual. The power source should be used with 115 volt power lines with a capacity of 60 amperes or greater. If 230 volt AC lines are used, their capacity should be 30 amperes or greater.

2.9 OUTPUT POWER WIRING

The power output wires should be large enough to avoid excessive line voltage drops. If it is desired to provide a zero output impedance at the load side of the power wiring, it is necessary that line drops be limited to approximately 1 to 2 percent of the required output voltage. Tables 2-6-1 through 2-6-4 list the minimum acceptable wire gauges for the different XP Series AC Power Sources for a 1.0 percent line drop.

2.10 DELTA AND WYE HOOKUP

Using the applicable multi-phase oscillator/power controller, at least two power amplifiers may be combined to provide two-phase and three-phase operation. For the available output VA in each configuration, refer to Table 2-7. Figure 2-2 illustrates the open DELTA configuration. Figure 2-3 illustrates the three-phase WYE configuration.

Any of the oscillators/power controllers described in Section 1.3.2 may be used to control either the DELTA or the WYE configuration.

2.11 POWER MONITOR VOLTAGE SENSE

In a three-phase system with an oscillator with no remote voltage sense capability, J2 of each phase is connected to TB2 of the same phase, High to High and Low to Low. J2 is used both as remote voltage sense input for ØA power source and also as voltage sense input for the power monitor in all the power sources. In a three-phase system with an oscillator with remote voltage sense capability, J2 of each phase is connected to the corresponding load. Make sure phasing is correct (High to High and Low to Low) otherwise catasrophic damage would occur.

At least two power sources can be connected in series for each phase. In this case, connect Low output of the first one to the High output of the second one. Use High on the first one and Low on the second one as the output terminals for that phase. J2 of each phase is connected to the corresponding load.

TABLE 2-6-1

OUTPUT WIRING FOR 1301XP

OUTPUT VOLTAGE	MAXIMUM LINE DROP	PEAK LOAD CURRENT	LOOP LENGTH	MINIMUM REQUIRED WIRE GAUGE
67.5 Volts	0.675 Volts	27.24 amps	20 feet	#14 wire
135 Volts	1.35 Volts	13.62 amps	20 feet	#20 wire
270 Volts	2.70 Volts	6.81 amps	20 feet	#26 wire

TABLE 2-6-2

OUTPUT WIRING FOR 971XP

OUTPUT VOLTAGE	MAXIMUM LINE DROP	PEAK LOAD CURRENT	LOOP LENGTH	MINIMUM REQUIRED WIRE GAUGE
67.5 Volts	0.675 Volts	20.43 amps	20 feet	#14 wire
135 Volts	1.35 Volts	10.213 amps	20 feet	#20 wire
270 Volts	2.70 Volts	5.107 amps	20 feet	#26 wire

NOTE

The wire size should be reduced 3 gauges every time that the distance between the power source and load is doubled.

TABLE 2-6-3

OUTPUT WIRNG FOR 651XP

OUTPUT VOLTAGE	MAXIMUM LINE DROP	PEAK LOAD CURRENT	LOOP LENGTH	MINIMUM REQUIRED WIRE GAUGE
67.5 Volts	0.675 Volts	13.62 amps	20 feet	#20 wire
135 Volts	1.35 Volts	6.81 amps	20 feet	#26 wire
270 Volts	2.70 Volts	3.405 amps	20 feet	#28 wire

TABLE 2-6-4

OUTPUT WIRING FOR 321XP

OUTPUT VOLTAGE	MAXIMUM LINE DROP	PEAK LOAD CURRENT	LOOP LENGTH	MINIMUM REQUIRED WIRE GAUGE
67.5 Volts	0.675 Volts	6.81 amps	20 feet	#26 wire
135 Volts	1.35 Volts	3.405 amps	20 feet	#28 wire
270 Volts	2.70 Volts	1.702 amps	20 feet	#28 wire

NOTE

The wire size should be reduced 3 gauges every time that the distance between the power source and load is doubled.

TABLE 2-7

MULTI-PHASE OUTPUT VA VALUES

	TA = 25 DEGREES C			TA = 55 DEGREES C		
UNIT	VA AT 2-PHASE	VA AT 3-PHASE OPEN DELTA	VA AT 3-PHASE WYE	VA AT 2-PHASE	VA AT 3-PHASE DELTA	VA AT 3-PHASE WYE
1301XP	2600 VA	2600 VA	3900 VA	2000 VA	2000 VA	3000 VA
971XP	1950 VA	1950 VA	2925 VA	1500 VA	1500 VA	2250 VA
651XP	1300 VA	1300 VA	1950 VA	1000 VA	1000 VA	1500 VA
321XP	650 VA	650 VA	975 VA	500 VA	500 VA	750 VA

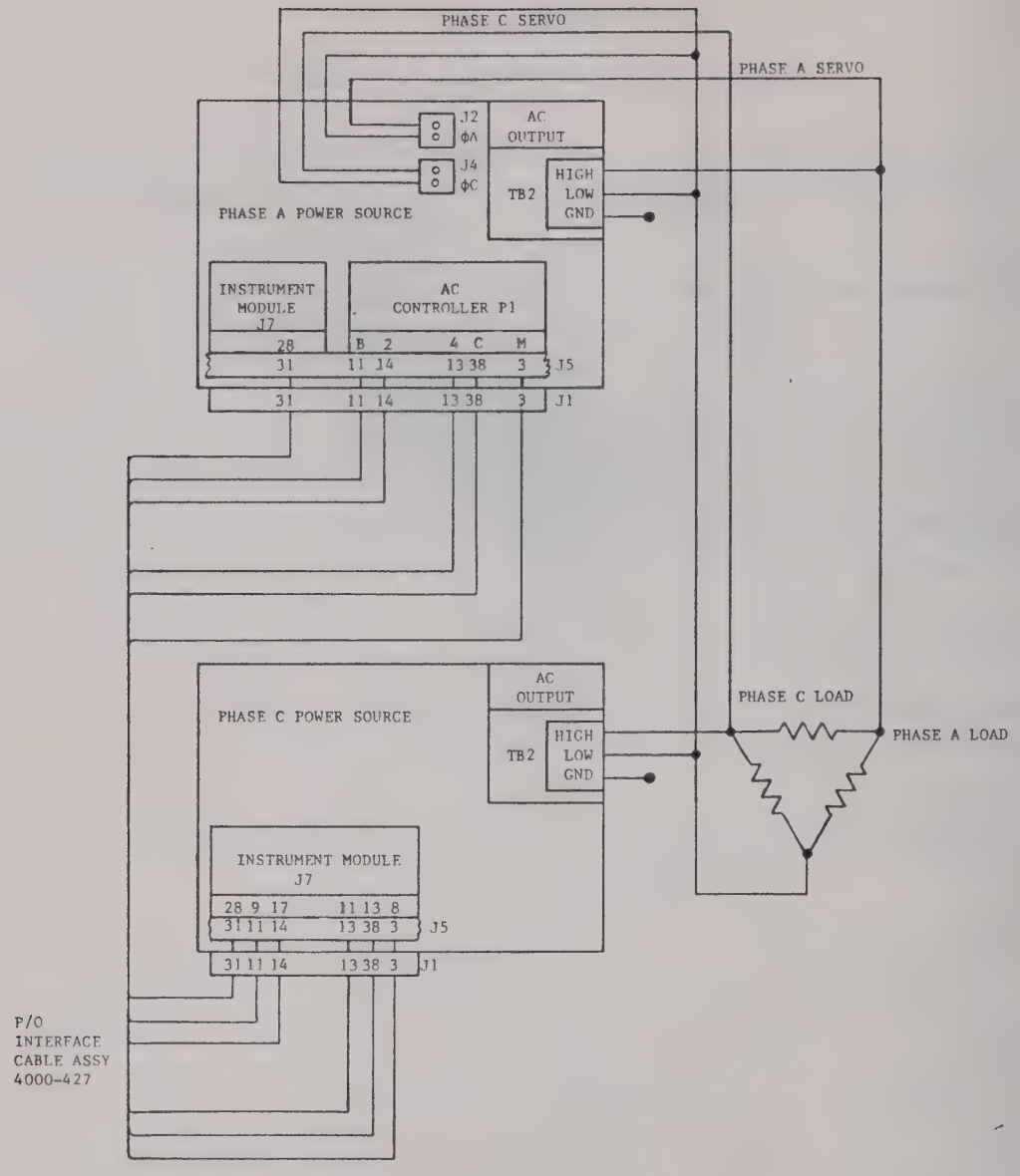


FIGURE 2-2 DELTA HOOKUP XP-SERIES

THREE-PHASE POWER SOURCE SYSTEM CONNECTIONS USING TWO INDIVIDUAL UNITS.

NOTE: SET THE PHASE SELECTOR IN EACH UNIT TO THE APPROPRIATE PHASE

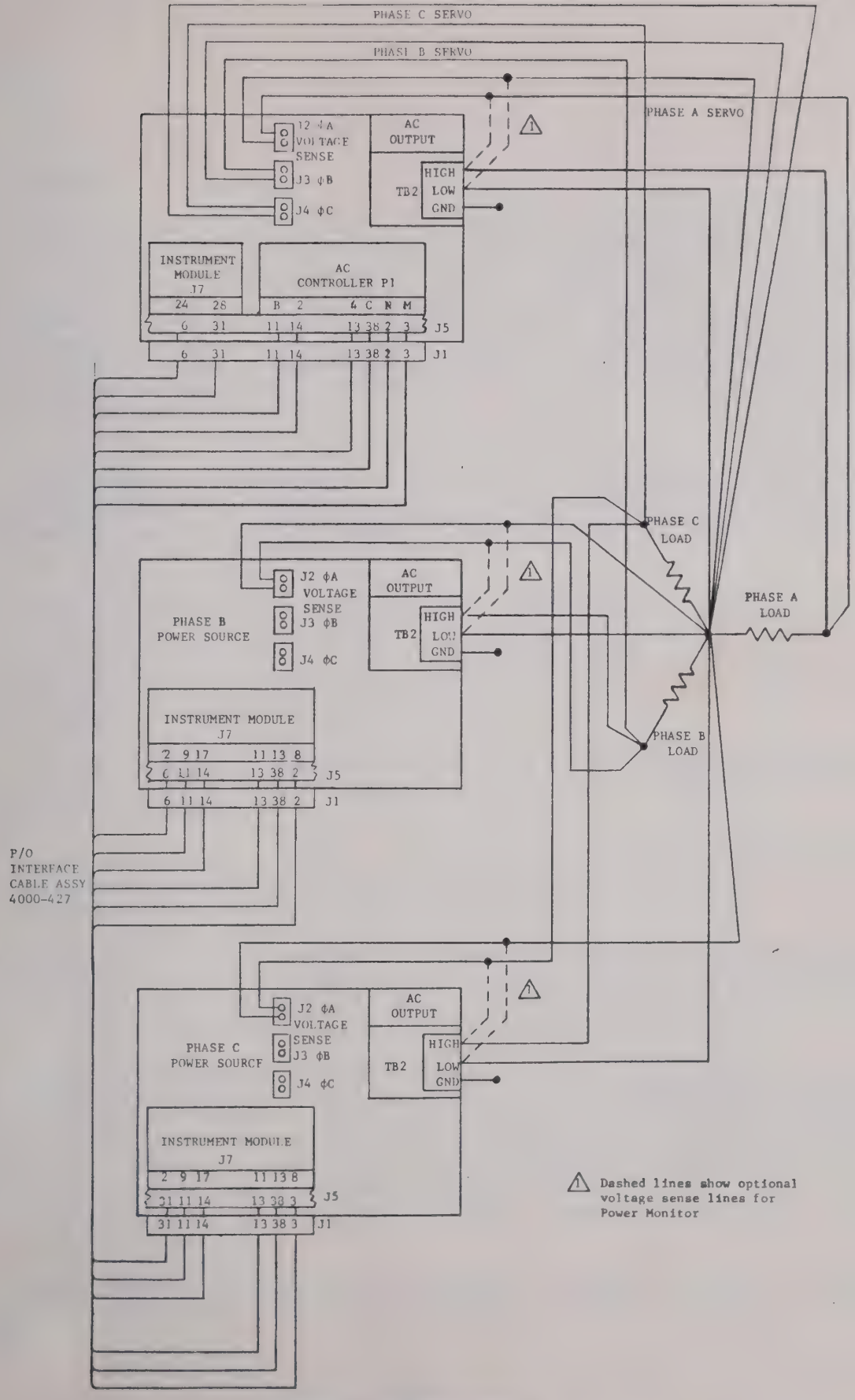


FIGURE 2-3 WYE HOOKUP XP-SERIES

THREE-PHASE POWER SOURCE SYSTEM CONNECTIONS USING THREE INDIVIDUAL UNITS

NOTE: SET THE PHASE SELECTOR IN EACH UNIT TO THE APPROPRIATE PHASE

SECTION III

THEORY OF OPERATION

3.1 GENERAL

A block diagram of the amplifier is shown in Figure 3-1. The input filter is a lowpass filter that prevents damage to the power source caused by accidental application of input frequencies above a certain frequency. Opto coupler, A3U2, and associated drive circuitry, disables the preamplifier input signal during a power supply fault condition, thermal overload, current overload and overpower condition. The preamplifier (G1, G2) is used to amplify the input signal to supply adequate drive to the power amplifier (G3).

The preamplifier board (A3) also contains the circuits for protection against overpower, overcurrent and thermal overload. A3 also contains the programmable current limit circuit and the temperature sense circuit which allows the unit to deliver more power at lower ambient temperatures.

The power amplifier (G3) provides the necessary sine wave signal to drive the output transformer T2. The output transformer has floating secondary windings which allow the load to float from the amplifier and oscillator circuitry. A local negative feedback signal is taken from the output of the G2 amplifier back to the input of the G2 amplifier.

The overall negative feedback is taken from the primary winding of T2 back to the non-inverting input of the preamplifier via A3R6, A3R7 and A3R8.

The positive voltage feedback loop provides a signal proportional to the load current and is used to compensate for losses. The degree of positive feedback is set by A3R5.

The four 67.5 volts secondary windings of T2 are connected in parallel for 0 to 67.5 volts output, series-parallel for 0 to 135 volts output and in series for 0 to 270 volts output. All of the transformer output ranges are selected using relay K1.

The rated VA output of the power source is, to a large extent, determined by the power dissipation in the quasi-complementary symmetry output stage. The power dissipation is determined by the power factor of the load, the output VA level of the amplifier, and by the actual output voltage expressed as a percentage of the rated output voltage. The derating chart, in the specifications at the front of the manual, expresses this derating in a graphical form.

When the power source is delivering its full rated output voltage, the output transformer T2 has 37.8 volts rms across the primary.

3.2 Detailed Circuit Description

A chassis level schematic diagram for the Model XP Series Power Source is shown in drawing 4000-088. All components not mounted directly on the chassis assembly, are designated as parts of a circuit board assembly. Tables 3-1 to 3-4 list the circuit board assemblies by their designators for the different XP-Series power sources.

All other components are a part of the top assembly. For information on the plug-in oscillator/power controller, consult the appropriate manual. For information on the plug-in instrument module, consult the appropriate manual. The drawings include typical voltage levels for the various sections of the power source.

3.2.1 Input Filter

Input filter FL-LP on the block diagram is a two pole active lowpass filter made up of one half of A3U1 and associated components. This filter is used to attenuate high frequency noises or signals applied to the preamplifier and power amplifier.

3.2.2 Preamplifier (G1,G2)

The preamplifier is the primary interface between the oscillator/power controller and the power amplifier. Its main functions are voltage gain, DC level shifting and stability compensation. The primary active element of G1 is op amp A3U3. The gain of this stage is set by A3R10 and A3R12.

G2 obtains its DC biasing through A3U4 and associated components along with A3R19 and Z11 (10K).

A3Q1 and A3Q4 provide DC level shifting while A3Q2 and A3Q5 provide voltage gain. A3Q3 and A3Q6 provide current gain to isolate the gain stage from the load. The closed loop gain of G2 is set by A3R22 and Z8 (10K).

3.2.3 Power Amplifier (G3)

The power amplifier, Q3, consists of Q13 through Q16 and associated components on the A3 board and heatsink assemblies A5, A6 and two of A4 for the 1301 units, A4, A5 and A7 for the 971 units, A4 and A6 for the 651 units, and A7 for the 321 units. Each of A4, A5, A6 and A7 heatsinks consists of Q1 through Q8 power transistors.

The positive half of the amplifier consists of two of A4 for the 1301 units, A4 and half of A7 for the 971 units, A4 for the 651 units, and half of A7 for the 321 units. Q13 and Q14 on the A3 board are drivers for the positive heatsinks in each unit. All transistors in the positive heatsinks are connected in the emitter follower configuration to provide the necessary current gain to drive the primary of the output transformer. These transistors supply different amperes depending on the type of unit. These transistors supply a total of 67 amperes peak for the 1301 units, a total of 50 amperes peak for the 971 units, a total of 33 amperes peak for the 651 units, and a total of 16.6 amperes peak for the 321 units during the positive half cycle of the output waveform at 25 degrees C and 78% of rated output voltage.

These transistors supply a total of 51 amperes peak for the 1301 units, a total of 38.5 amperes peak for the 971 units, a total of 25.5 amperes peak for the 651 units and a total of 12.75 amperes peak for the 321 units during the positive half cycle of the output waveform at 55 degrees C and 78% of rated output voltage.

Th negative half of the power amplifier consists of A5 and A6 for the 1301 units, A5 and half of A7 for the 971 units, A6 for the 651 units and half of A7 for the 321 units. Q15 and Q16 on A3 board are connected in the quasi-pnp configuration and they drive the negative heatsinks in each unit. All the transistors in the negative heatsinks are connected in the emitter follower configuration to provide the necessary current gain to drive the primary of the output transformer. These transistors supply the same amount of current as the transistors in the positive heatsink at 25 degrees C and 55 degrees C during the negative half cycle of the output waveform at 78% of rated output voltage.

The primary of the output transformer has a 37.8 volt rms signal when the power source is delivering its full rated output voltage.

3.2.4 Output Range Selection

The output range change relay, K1 is activated by a range relay driver signal generated by the plug-in instrument module. The instrument module generates the signal either in response to its own front panel range control or in response to a range signal from the plug-in oscillator/AC power controller installed in the unit.

TABLE 3-1

CIRCUIT BOARD LISTING 1301XP

DESIGNATOR	ASSEMBLY NUMBER	SCHEMATIC	NAME
A1	4000-713	4000-088	PC ASSEMBLY, MOTHER BOARD
A2	4000-700	4000-081	PC ASSEMBLY, FILTER
A3	4000-710	4000-080	PC ASSEMBLY, PREAMPLIFIER
A4,A5,A6	4000-401	4000-088	HEATSINK ASSY POWER AMP.

TABLE 3-2

CIRCUIT BOARD LISTING 971XP

DESIGNATOR	ASSEMBLY NUMBER	SCHEMATIC	NAME
A1	4000-714	4000-088	PC ASSEMBLY, MOTHER BOARD
A2	4000-700	4000-081	PC ASSEMBLY, FILTER
A3	4000-710	4000-080	PC ASSEMBLY, PREAMPLIFIER
A4,A5	4000-401	4000-088	HEATSINK ASSY POWER AMP
A7	4000-400	4000-088	HEATSINK SUB-ASSEMBLY POWER AMP

TABLE 3-3

CIRCUIT BOARD LISTING 651XP

DESIGNATOR	ASSEMBLY NUMBER	SCHEMATIC	NAME
A1	4000-714	4000-088	PC ASSEMBLY, MOTHER BOARD
A2	4000-700	4000-081	PC ASSEMBLY, FILTER
A3	4000-710	4000-080	PC ASSEMBLY, PREAMPLIFIER
A4,A6	4000-401	4000-088	HEATSINK ASSY POWER AMP

TABLE 3-4

CIRCUIT BOARD LISTING 321XP

DESIGNATOR	ASSEMBLY NUMBER	SCHEMATIC	NAME
A1	4000-714	4000-088	PC ASSEMBLY, MOTHER BOARD
A2	4000-700	4000-081	PC ASSEMBLY, FILTER
A3	4000-710	4000-080	PC ASSEMBLY, PREAMPLIFIER
A7	4000-400	4000-088	HEATSINK SUB-ASSEMBLY POWER AMP

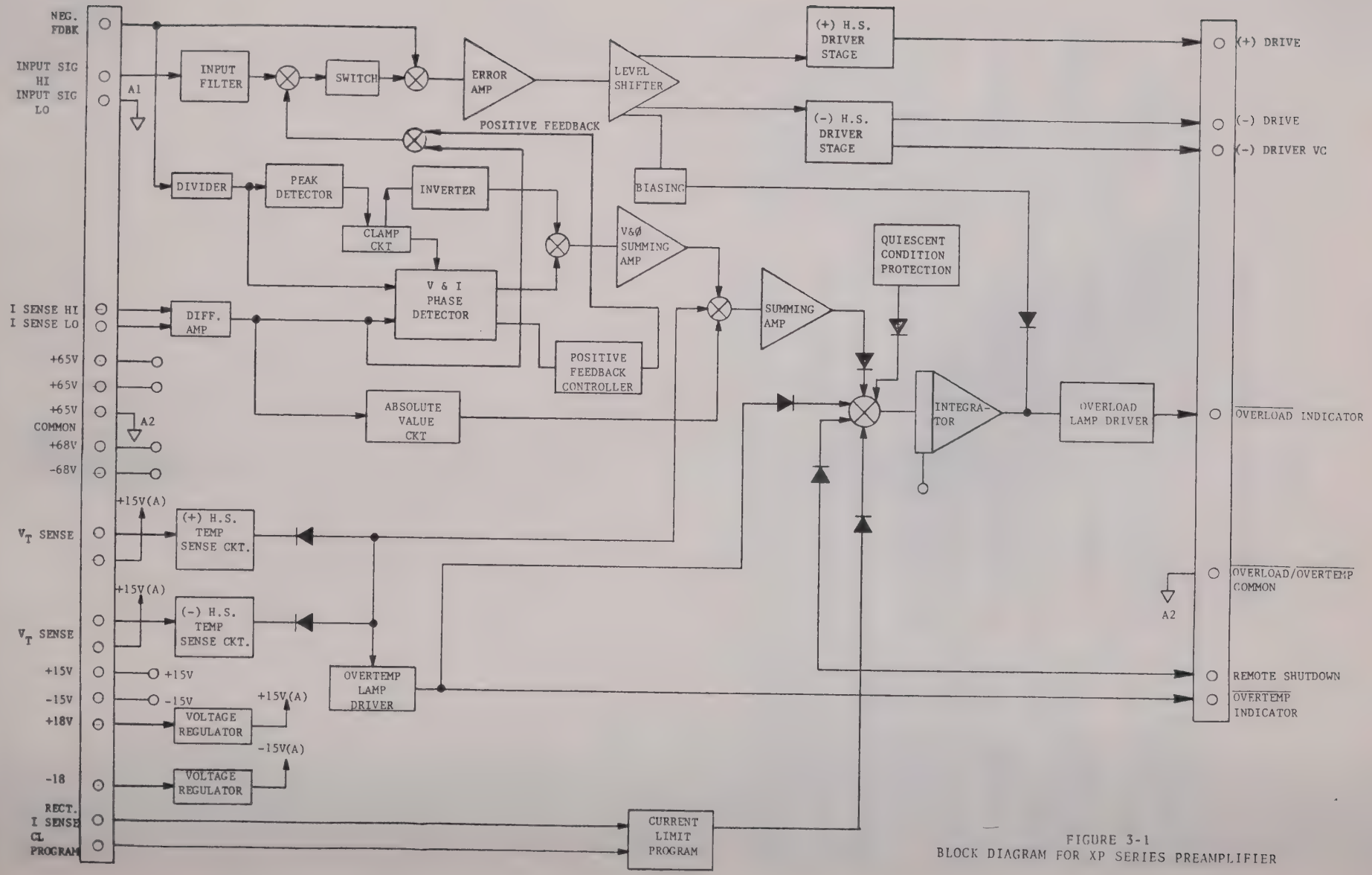


FIGURE 3-1
BLOCK DIAGRAM FOR XP SERIES PREAMPLIFIER

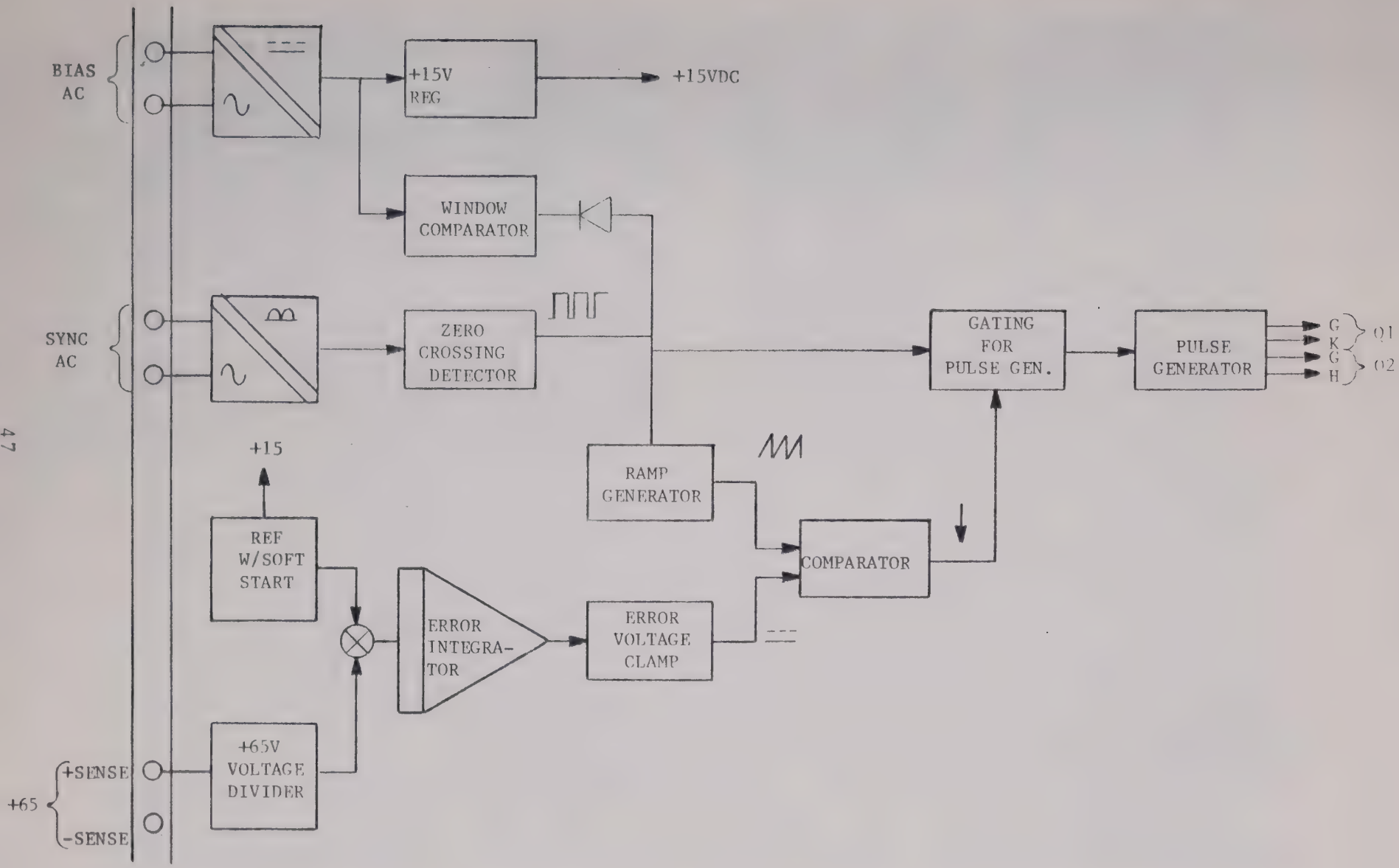


FIGURE 3-2
BLOCK DIAGRAM FOR XP SERIES
POWER SUPPLY REGULATOR

3.2.5 Positive Voltage Feedback

The positive voltage feedback loop provides a signal proportional to the load current and is used to compensate for losses. A 0.01 ohm resistor in the current path of T2 transformer senses the current and provides a voltage signal to feed it to the overcurrent circuitry on the preamplifier board. This signal is amplified through A3U11 and is fed back in phase with the oscillator/power controller signal. The degree of positive feedback is set with A3R5. The components R107, R113, C69 and C47 on the A3 board improve the regulation at high frequency. The purpose of C4 is to receive positive feedback for better stability at high frequency.

3.2.6 Power Supply Fault Condition

The ±18 volt supplies in the unit are monitored by programmable zener diode A3VR5. The programmed set point is established by A3R31 and A3R79 such that the differential voltage between the two supplies must exceed 27 volts to enable the preamplifier via A3Q9, half of A3U10 and A3U2. When the differential voltage is reached, A3Q9 is turned on, A3CR20 is turned on, output of A3U10 is low, output of the other half of A3U10 (integrator) is high and hence the photo-FET is turned on. A3U2 has less than 200 ohms when in the full on condition.

3.2.7 Current Limit Programming

The programmable current limit circuitry in the preamplfier is used to prevent the unit from delivering more current than it is programmed to produce. The programmed DC voltage sent by the oscillator/power controller is equivalent to the amount of allowable peak current at the output. This is summed through A3U17 with a small biasing voltage and the full-wave rectified signal of the output current. The integrator begins its limiting function when the output current exceeds the programmed value.

3.2.8 Overload and Overpower Protection

Overcurrent and overpower protection from overloads, shorts and negative power factors is provided by divider (A3R15, A3R16), peak detector (half of A3U7 and half of A3U5 and their associated components), clamp circuit (A3VR4 and its associated components), invertor (half of A3U7 and its associated components), voltage and current phase detector (A3U5, A3U6, A3U8, A3Q8 and their associated components), and voltage and phase summing amplifier (half of A3U9 and its associated components) for overpower conditions. Overcurrent protection is provided by the differential amplifier and the absolute value circuit (A3U11 and its associated components). The power signal, which is a function of output voltage and power factor, the current signal which is the equivalent of output current and heatsink

temperature sense signal are summed together through half of A3U9 and its associated components. Under an overpower or overcurrent condition at a specific ambient temperature, the output of A3U9 goes high and whenever it passes the threshold voltage of A3U10, (integrator), the integrator output goes down, reducing the current through A3U2. The circuit also goes into limiting for the same current or power condition but at higher ambient temperature than what was set originally.

When the circuit goes into limiting, the overload lamp illuminates.

3.2.9 Temperature Sense Circuit

The heatsink temperature is sensed by a temperature transducer and is fed back into the temperature sense circuit on the preamplifier board. The temperature sense circuit consists of A3U12 and its associated components, A3CR15 and A3CR16.

For ambient temperatures less than 55 degrees C down to 25 degrees C, the output of A3U12 ramps up as the temperature drops lower.

At 25 degrees C ambient and at 81 degrees C of heatsink temperature, A3CR15 and A3CR16 are reverse-biased and the temperature sense voltage is provided by the 15 volt supply and voltage divider, A3R56 and A3R65. As the ambient temperature and hence the heatsink temperature rises, the output voltage of A3U12 drops lower until A3CR15 and A3CR16 are turned on. If either of the negative heatsinks or the positive heatsinks become warm earlier, the corresponding diode (A3CR16 or A3CR15 respectively) would also turn on earlier. In this manner the heatsinks are protected against any thermal overload. The temperature sense signal is summed with power signal and current sense signal through part of A3U9. This voltage allows more power to be delivered to the output at temperatures less than 55 degrees C.

At 55 degrees C ambient or 98 degrees C of heatsink temperature, the output of A3U12 is zero and diodes A3CR15 and A3CR16 are fully on, causing the temperature sense voltage going to part of A3U9 to become zero. At this stage, the comparator A3U13 is turned on in inverting mode. Its output goes high and turns on A3Q10 which drives the overtemperature lamp. The high output of A3U13 also forces the output of integrator A3U10 to go low, turning off the photo-FET, turning on the overload lamp, and turning off the level shifter.

3.2.10 Integrator

Under any type of fault condition, the output of A3U10 goes low whenever the input is greater than the threshold voltage. The threshold voltage is set by a +15 volt supply, A3R45 and A3R46. Under soft limiting situations the A3Q11, A3CR35 and A3U2 are partially off depending on the level of limiting. Under hard limiting situations, the output of the integrator is close to zero. Diode A3CR25 is turned on fully, and hence the bias current is taken away from the level shifter, forcing the level shifter to turn off. A3Q11, A3CR35 and A3U2 are completely turned off while the overload lamp is turned on. By removing the fault load from the output of the power source, the unit comes out of fault mode and it goes to its normal operation.

Whenever output of A3U10 goes low, A3CR26 and A3Q12 are turned on and hence the overload lamp on the instrument module is turned on.

3.2.11 Main Power Supply

A block diagram for the main DC power supply is shown in Figure 3-2. This power supply delivers ±64 volts ±0.5%, at 21.5 amperes DC with less than 4 volts peak-to-peak ripple from the 115/230V 60/50 Hz AC line. These regulated supplies consist of the following sections.

Bias AC is converted into raw DC voltage through A3CR40. The raw DC goes to +15 volt regulator A3VR11 to provide 15 volt regulated supply.

The raw DC voltage is fed into the window comparator. The window comparator consists of two sections of A3U22 and associated components. A3VR12 sets 2.5 volts threshold for A3U22. When the input voltage is lower than the lower limit, A3CR43 is on and output of the zero crossing detector is off. When the lower limit is reached, A3CR43 is turned off which then allows the operation of the power supply circuit. Both diodes A3CR43 and A3CR45 are off within the window limit. When the upper limit is reached, A3CR45 is fully turned on which makes the output of the zero crossing detector go low and disables the operation of the power supply.

The sync AC is converted into a full-wave rectified signal by A3CR41; this signal goes to the zero crossing detector. The zero crossing detector consists of the third section of A3U22 and its associated components. The output of this detector is a set of pulses which is fed into A3U25 and the ramp generator circuit. +Sense voltage of 64 volts is divided through A3R80, A3R89 and A3R90 and is fed to the input of the integrator, A3U24. This voltage is summed with the reference signal with soft start generated by A3Q18, A3VR1 and their associated components. The resultant DC voltage, called error voltage, at the output A3U24 of the integrator is fed into the comparator part of A3U22.

The error voltage is clamped between two limits, 1.4 volts set by A3CR42 and A3CR44, and 13 volts set by A3VR13, A3R11 and A3R95. The ramp generator consists of the A3Q21, A3Q19 and A3Q17 and their associated components. During zero crossing, A3Q17 is turned on, which turns on A3Q21 and hence A3C33 is discharged rapidly. When the zero crossing point is passed, A3Q17 is turned off which turns off A3Q21 and hence A3C33 is charged up through the constant current source, A3Q19 and its associated components. The ramp signal is compared with the error voltage. Whenever the ramp voltage is higher than the error voltage, the output of the comparator goes low.

The gating for the pulse generator consists of A3U25 and its associated components. Each time the output of the comparator goes low, the monostable timer, half of A3U25, is triggered and hence enables the astable timer (the other half of A3U25) for about 10 msec (monostable times out after 10 msec). The astable timer generates a set of pulses of 10% duty cycle. These pulses drive the pulse generator, A3Q20 and A3T1 and their associated components. For each pulse, A3Q20 is turned on and the transferred pulses through A3T1 drive the gates of SCR5, Q1 and Q2.

3.2.12 Auxiliary Power Supply

A schematic diagram for the DC power supply is part of drawing 4000-080. The auxiliary power supply consists of +5 VDC, +8 VDC, ±15 VDC, ±18 VDC and ±66 VDC. The +5 VAC is rectified and filtered to +8 VDC at 500 mA through A3CR37, A3C19 and A3C20 to be used in the oscillator/AC controller used with XP-Series. The +8 volts DC is regulated to the +5 volts DC at 650 mA through A3VR8 to be used in XP-Series instrument module.

The ±15 volts AC are rectified and filtered to ±18 volts DC at 75 mA through A3CR38, A3C21 and A3C22 to be used in XP-Series instrument module, preamplifier and the oscillator/AC controller. The ±18 volts DC are regulated to the ±15 volts DC at 180 mA for +15 volts and 90 mA for -15 volts, through A3VR9, A3UR10, A3C44 and A3C45 to be used in the preamplifier section of the A3 board.

The ±66 volts AC is rectified and filtered to ±66 volts DC at 12 mA for each, through A3CR39 and A3CR23-CR26 to be used for the preamplifier output stage. Because these supplies are higher than the main power supplies (±64 volts), the preamplifier output stage is kept from saturating. Typical ripple is less than 0.5 volts, peak-to-peak.

WARNING

HIGH VOLTAGE (270 VAC)

Voltages up to 270 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

On contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with the primary power circuits, and the output circuits of the power source.

SECTION IV

CALIBRATION PROCEDURE

4.1 GENERAL

The following calibration and test procedures, or any part of them, may be performed on a routine basis to ensure that the XP Series Power Source remain within specification tolerances. These procedures should always be performed after any repairs have been made to the unit. For your convenience, Table 4-1 lists the paragraph titles and page numbers for the calibration and test procedures.

Table 4-1 Calibration Procedure Listing

PARAGRAPH	PROCEDURE	PAGE
4.2	TEST EQUIPMENT REQUIRED.	54
4.3	INITIAL ADJUSTMENTS.	64
4.4	MEASURE POWER SUPPLY VOLTAGES.	64
4.5	TEMPERATURE LIMIT TEST	64
4.6	POWER LIMIT TEST	71
4.7	MAXIMUM LOAD INPUT POWER TEST.	71
4.8	LINE REGULATION TEST	73
4.9	LOAD REGULATION TEST	73
4.10	HARMONIC DISTORTION TEST	74
4.11	FREQUENCY RESPONSE TEST.	75
4.12	AC NOISE LEVEL TEST.	75
4.13	0.7 LAGGING POWER FACTOR TEST.	76
4.14	0.7 LEADING POWER FACTOR TEST.	77
4.15	PROGRAMMABLE CURRENT LIMIT TEST.	86
4.16	OVERLOAD TEST.	87
4.17	24 HOUR AMPLITUDE STABILITY TEST	88

This calibration procedure requires that the 321XP and 651XP power sources are tested using a 115 volt, 48 to 65 Hz AC line. The 971XP and 1301XP power sources are tested using a 230 volt, 48 to 65 Hz AC line. The XP series have a programmable range change built into their design. The standard range is 135 to 270 volts. The standard units can be altered to provide a 67.5 to 135 volt range by rearranging jumpers on the output transformer.

For operation from the 115 volt AC line, a 120 volt autotransformer and a 120 volt wattmeter must be substituted for those called out in this procedure. Consult Section 2.2.1 of this instruction manual for operation from other than the 230 volt AC line.

This calibration procedure further assumes that the power source is tested on the 135 to 270 volt range. Performance is very similar on the 67.5 to 135 volt range. Tables 4-3-1 through 4-3-4 list output voltages, load settings and tolerances for both voltage ranges for XP Series power sources. When checking load regulation and amplitude stability, care should be taken to use a four wire connection such that the external load and the measurement equipment have completely separate wiring from the large AC output terminal strip located at the rear of the power source.

TABLE 4-2

ADJUSTABLE COMPONENT LISTING

CIRCUIT DESIGNATOR	VALUE	DESCRIPTION
A3		Preamplifier/Power Supply Circuit Board
A3 R5	5K	Load Regulation Adjustment
A3 R8	100K	Preamplifier Gain Adjustment
A3 R89	5K	Power Supply Output Adjustment
A3 R126	50K	Programmable Current Limit Adjustment

NOTE: All resistors are in ohms

4.2 TEST EQUIPMENT REQUIRED

The following test equipment is required to perform the calibration procedure assuming that the input voltage has a nominal value of 230 volts rms and that the power source is tested on the 0 to 130 volt AC range.

a. Oscilloscope, Tektronix 5110N with 5A22N and 5B10N.

b. 5 KVA autotransformer, General Radio 2XW50M or equivalent.

c. Power analyzer, Magtrol 4610 or equivalent.

d. Distortion analyzer, Krohn-Hite Model 6800 or equivalent.

e. Distortion analyzer, Hewlett Packard Model 333A.

f. Multimeter, Keithly 190 Programmable DMM or equivalent.

g. Multirange load box or individual power resistors as defined in Tables 4-3-1 through 4-3-4 with proper power capability. Use Dale type NHL resistors or equivalent.

h. Expanded scale (about 115 VAC) strip chart recorder, Voltron Model 89.038 or equivalent.

i. Model 850XP or 900XP series sine wave oscillator/power controller or external low distortion sine wave generator.

TABLE 4-3-1A

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES FOR 1301XP AT FULL RATED OUTPUT

100% OF RATED OUTPUT	67.5 VAC	135 VAC	270 VAC
Resistive load for 1300VA output	3.5 ohms	14.0 ohms	56.1 ohms
Resistive load for 1000VA output	4.56 ohms	18.2 ohms	72.9 ohms
Line Regulation ±0.1%	0.07 VAC	0.14 VAC	0.27 VAC
Load Regulation ±1%	0.7 VAC	1.35 VAC	2.7 VAC
AC Noise level			
-70dB rms shorted input	0.02V rms	0.043V rms	0.09V rms
-60dB P-P shorted input	0.2V P-P	0.4V P-P	0.764V P-P
-60dB rms at full power	0.07V rms	0.135V rms	0.27V rms
-50dB P-P at full power	0.6V P-P	1.21V P-P	2.42V P-P
Amplitude Stability (±0.25%)	0.17 VAC	0.34 VAC	0.67 VAC
Frequency Response ±0.5 dB	4 VAC	8 VAC	16 VAC

NOTE

All loads must be able to dissipate 1300VA at TA=25 degrees C and 1000VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-1B

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES
FOR 1301XP AT 78% RATED OUTPUT

78% of Rated Output	52.5 VAC	105 VAC	210 VAC
Resistive Load for 1300VA output	2.12 ohms	8.5 ohms	34 ohms
Resistive Load for 1000VA output	2.76 ohms	11 ohms	44.1 ohms
Line Regulation (±0.1%)	0.53 VAC	0.11 VAC	0.21 VAC
Load Regulation (±1%)	0.53 VAC	1.1 VAC	2.1 VAC
AC Noise Level			
-70dB rms shorted input	0.02V rms	0.03V rms	0.07V rms
-60dB P-P shorted input	0.15V P-P	0.3V P-P	0.6V P-P
-60dB rms at full power	0.05V rms	0.1V rms	0.21V rms
-50db P-P at full power	0.47V P-P	0.94V P-P	1.9V P-P
Amplitude Stability	0.13 VAC	0.26 VAC	0.52 VAC

NOTE

All loads must be able to dissipate 1300VA at TA=25 degrees C and 1000VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-2A

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES FOR 971XP AT 100% RATED OUTPUT

100% OF RATED OUTPUT	67.5 VAC	135 VAC	270 VAC
Resistive load for 975VA output	4.7 ohms	18.7 ohms	74.8 ohms
Resistive load for 750VA output	6.1 ohms	24.3 ohms	97.2 ohms
Line Regulation ±0.1%	0.07 VAC	0.14 VAC	0.27 VAC
Load Regulation ±1%	0.7 VAC	1.35 VAC	2.7 VAC
AC Noise level			
-70dB rms shorted input	0.02V rms	0.04V rms	0.09V rms
-60dB P-P shorted input	0.2V P-P	0.4V P-P	0.76V P-P
-60dB rms at full power	0.07V rms	0.14V rms	0.27V rms
-50dB P-P at full power	0.6V P-P	1.21V P-P	2.42V P-P
Amplitude Stability (±0.25%)	0.17 VAC	0.34 VAC	0.67 VAC
Frequency Response ±0.5 dB	4 VAC	8 VAC	16 VAC

NOTE

All loads must be able to dissipate 975VA at TA=25 degrees C and 750VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-2B

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES
FOR 971XP AT 78% RATED OUTPUT

78% of Rated Output	52.5 VAC	1105 VAC	210 VAC
Resistive Load for 975VA output	2.83 ohms	11.3 ohms	45.23 ohms
Resistive Load for 750VA output	3.7 ohms	14.7 ohms	58.8 ohms
Line Regulation (±0.1%)	0.53 VAC	0.11 VAC	0.21 VAC
Load Regulation (±1%)	0.53 VAC	1.1 VAC	2.1 VAC
AC Noise Level			
-70dB rms shorted input	0.02V rms	0.04V rms	0.07V rms
-60dB P-P shorted input	0.145V P-P	0.3V P-P	0.6V P-P
-60dB rms at full power	0.05V rms	0.11V rms	0.21V rms
-50db P-P at full power	0.47V P-P	0.94V P-P	1.88V P-P
Amplitude Stability	0.013 VAC	0.3 VAC	0.53 VAC

NOTE

All loads must be able to dissipate 975VA at TA=25 degrees C and 750VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-3A

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES
FOR 651XP AT 100% RATED OUTPUT

100% OF RATED OUTPUT	67.5 VAC	135 VAC	270 VAC
Resistive load for 650VA output	7 ohms	28 ohms	112.2 ohms
Resistive load for 500VA output	9.11 ohms	36.45 ohms	145.8 ohms
Line Regulation ±0.1%	0.07 VAC	0.14 VAC	0.27 VAC
Load Regulation ±1%	0.675 VAC	1.4 VAC	2.7 VAC
AC Noise level			
-70dB rms shorted input	0.02V rms	0.04V rms	0.09V rms
-60dB P-P shorted input	0.2V P-P	0.4V P-P	0.8V P-P
-60dB rms at full power	0.07V rms	0.14V rms	0.27V rms
-50dB P-P at full power	0.6V P-P	1.21V P-P	2.42V P-P
Amplitude Stability (±0.25%)	0.17 VAC	0.334 VAC	0.675 VAC
Frequency Response ±0.5 dB	4 VAC	8 VAC	16 VAC

NOTE

All loads must be able to dissipate 650VA at TA=25 degrees C and 500VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-3B

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES
FOR 651XP AT 78% RATED OUTPUT

78% of Rated Output	52.5 VAC	1105 VAC	210 VAC
Resistive Load for 650VA output	4.24 ohms	17 ohms	68 ohms
Resistive Load for 500VA output	5.41 ohms	22 ohms	88.2 ohms
Line Regulation (±0.1%)	0.53 VAC	0.11 VAC	0.21 VAC
Load Regulation (±1%)	0.53 VAC	1.1 VAC	2.1 VAC
AC Noise Level			
-70dB rms shorted input	0.02V rms	0.03V rms	0.07V rms
-60dB P-P shorted input	0.15V P-P	0.3V P-P	0.6V P-P
-60dB rms at full power	0.053V rms	0.11V rms	0.21V rms
-50db P-P at full power	0.47V P-P	0.94V P-P	1.88V P-P
Amplitude Stability	0.13 VAC	0.26 VAC	0.53 VAC

NOTE

All loads must be able to dissipate 650VA at TA=25 degrees C and 500VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-4A

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES FOR 321XP AT 100% RATED OUTPUT

100% OF RATED OUTPUT	67.5 VAC	135 VAC	270 VAC
Resistive load for 325VA output	14.02 ohms	56.1 ohms	224.3 ohms
Resistive load for 250VA output	18.23 ohms	73 ohms	291.6 ohms
Line Regulation ±0.1%	0.07 VAC	0.14 VAC	0.27 VAC
Load Regulation ±1%	0.7 VAC	1.4 VAC	2.7 VAC
AC Noise level			
-70dB rms shorted input	0.021V rms	0.043V rms	0.1V rms
-60dB P-P shorted input	0.2V P-P	0.4V P-P	0.8V P-P
-60dB rms at full power	0.07V rms	0.14V rms	0.27V rms
-50dB P-P at full power	0.6V P-P	1.21V P-P	2.42V P-P
Amplitude Stability (±0.25%)	0.17 VAC	0.34 VAC	0.7 VAC
Frequency Response ±0.5 dB	4 VAC	8 VAC	16 VAC

NOTE

All loads must be able to dissipate 325VA at TA=25 degrees C and 250VA at TA=55 degrees C and have no inductive or capacitive reactance.

TABLE 4-3-4B

CALIBRATION OUTPUT VOLTAGES, LOAD SETTINGS AND TOLERANCES
FOR 321XP AT 78% RATED OUTPUT

78% of Rated Output	52.5 VAC	1105 VAC	210 VAC
Resistive Load for 325VA output	8.5 ohms	17 ohms	68 ohms
Resistive Load for 250VA output	11 ohms	22 ohms	88.2 ohms
Line Regulation (±0.1%)	0.53 VAC	0.11 VAC	0.21 VAC
Load Regulation (±1%)	0.53 VAC	1.1 VAC	2.1 VAC
AC Noise Level			
-70dB rms shorted input	0.02V rms	0.03V rms	0.07V rms
-60dB P-P shorted input	0.15V P-P	0.3V P-P	0.6V P-P
-60dB rms at full power	0.053V rms	0.11V rms	0.21V rms
-50db P-P at full power	0.47V P-P	0.94V P-P	1.88V P-P
Amplitude Stability	0.13 VAC	0.3 VAC	0.53 VAC

NOTE

All loads must be able to dissipate 325VA at TA=25 degrees C and 250VA at TA=55 degrees C and have no inductive or capacitive reactance.

4.3 INITIAL ADJUSTMENTS

Check input power level:

1. Connect the XP Series Power Source input as shown in Figure 4-2 and power output as shown in Figure 4-4 and 4-5 through 4-12.

2. Turn the GAIN control of the oscillator/AC controller fully counterclockwise.

3. Adjust the autotransformer for nominal input voltage to 115 VAC for the 321XP and the 651XP or 230 VAC for the 971XP and the 1301XP

4. Turn circuit breaker "ON". The wattmeter should indicate equal to or less than 40 watts for 321XP, 70 watts for 651XP, 90 watts for 971XP and 180 watts for 1301XP power sources.

4.4 MEASURE POWER SUPPLY VOLTAGES

DC Power Supply voltages may be measured at the test points indicated in Table 4-4 and Figure 4-1. The proper voltage values are given in Table 4-4.

4.5 TEMPERATURE LIMIT TEST

The following test is used to check the operation of the XP series temperature sensors.

If not already accomplished, connect the power source and test equipment as per Figure 4-4.

NOTE

To make the following test valid, the ambient temperature of the room must be known.

1. Adjust the autotransformer for nominal input, 115 VAC for the 321XP and the 651XP or 230 VAC for the 971XP and 1301XP.

2. Turn the unit "ON"

3. Attach voltmeter leads to the common cathode of CR15 and CR16. At an ambient temperature of 25 degrees C, the voltmeter should read 6.42 volts $\pm$3%. The reading will drop linearly at -.227 volts/degree C until a zero volt reading is obtained at an ambient temperature of 55 degrees C.

4. Verify A3DS1 is lighted (green). If lighted, the amplifier is ready to put out a signal and all protection circuitry is working properly.

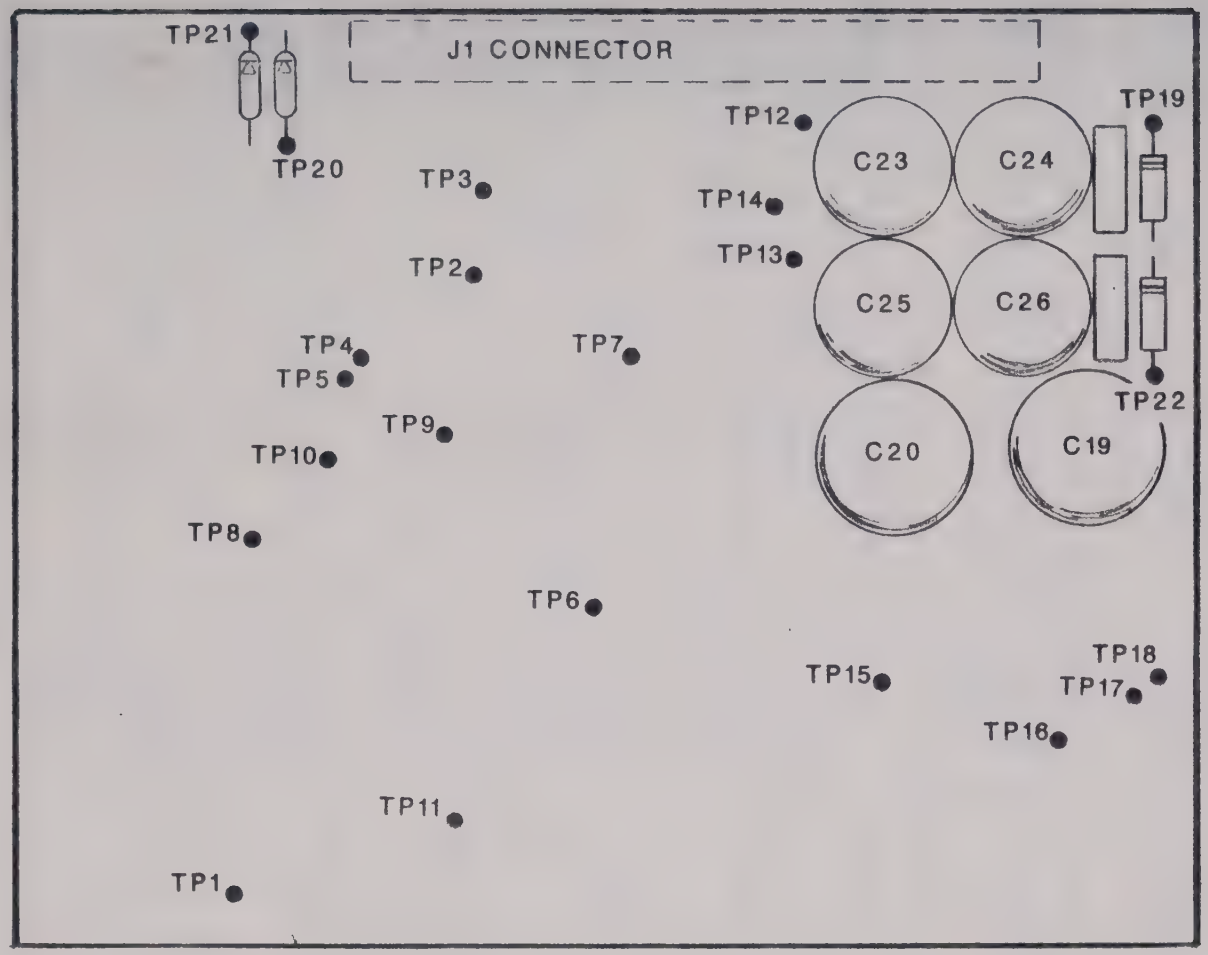


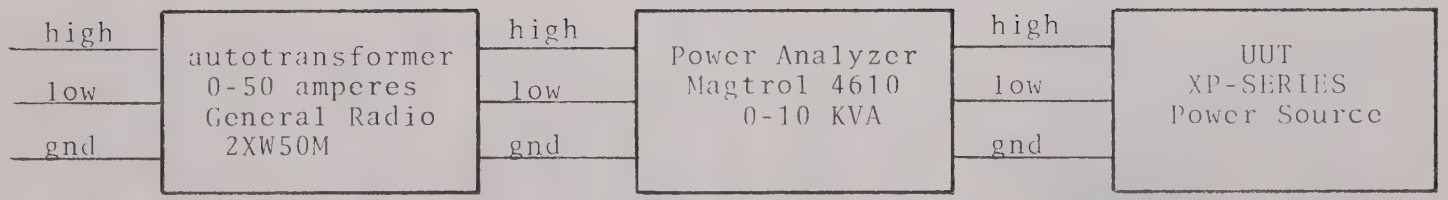
FIGURE 4-1. "" Series DC Power Supply/
Preamplifier Test Points

Table 4-4
DC Power Supply/Preamplifier Test Points

TEST POINT #1	TEST POINT DEFINITION	VALUE AT TEST POINT
TP1	Negative Feedback	37.8V rms at 100% rated output
TP2	Preamplifier Input	5 volts rms (typical)
TP3	Level shifter error signal	0V DC
TP4	Output transformer primary	37.8V rms at 100% rated output
TP5	Output of summing amplifier	The value depends on degree of limiting < > 3.225V
TP6	Output of diff. amplifier equivalent to amplified current sense signal	10V ±2% pk max. at TA=25 7.67 ±2% pk max at TA=55
TP7	Output of error amplifier (U3)	Sine wave signal
TP8	Output of power sense circuit	8.42V ±2% max. from 100% to 78% rated and 0 to 45 phase shift at output
TP9	Output of quiescent condition protection circuit	0 to 15 volts DC

TABLE 4-4 (CONT.)

TEST POINT #1	TEST POINT DEFINITION	VALUE AT TEST POINT
TP10	Output of quiescent condition sense circuit	0 to 13.5 volts DC
TP11	Output of temp. sense circuit	6.42V ±.19 max at TA=25 C 0V at TA=55 C
TP12	Power supply common	0 VDC
TP13	+15 VDC supply	+15 VDC ±.75V
TP14	-18 V supply	-18 VDC ±4V
TP15	-15 VDC supply	-15 VDC ±.75V
TP16	+18 VDC supply	+18 VDC ±4V
TP17	+5 VDC supply	+5 VDC ±.2V
TP18	+8 supply	+8 VDC ±2V
TP19	+68 VDC supply	+68 VDC ±4V
TP20	+65 power supply section of A3	+65 VDC ±.2V
TP21	-65 VDC supply	-65 VDC ±0.2V
TP22	-68 VDC supply	-68 VDC ±4V
TP23	+15 volt regulator in power supply section of A3	+15 VDC ±.75V



See Table 2-1 for AC line input wiring to the XP-Series Power Source. Unit is normally wired for 115 ±10 volts for 321XP and 651XP or 230 ±20 volts for 971XP and 1301XP AC line operation.

FIGURE 4-2. XP-Series AC Input Power Connection Diagram

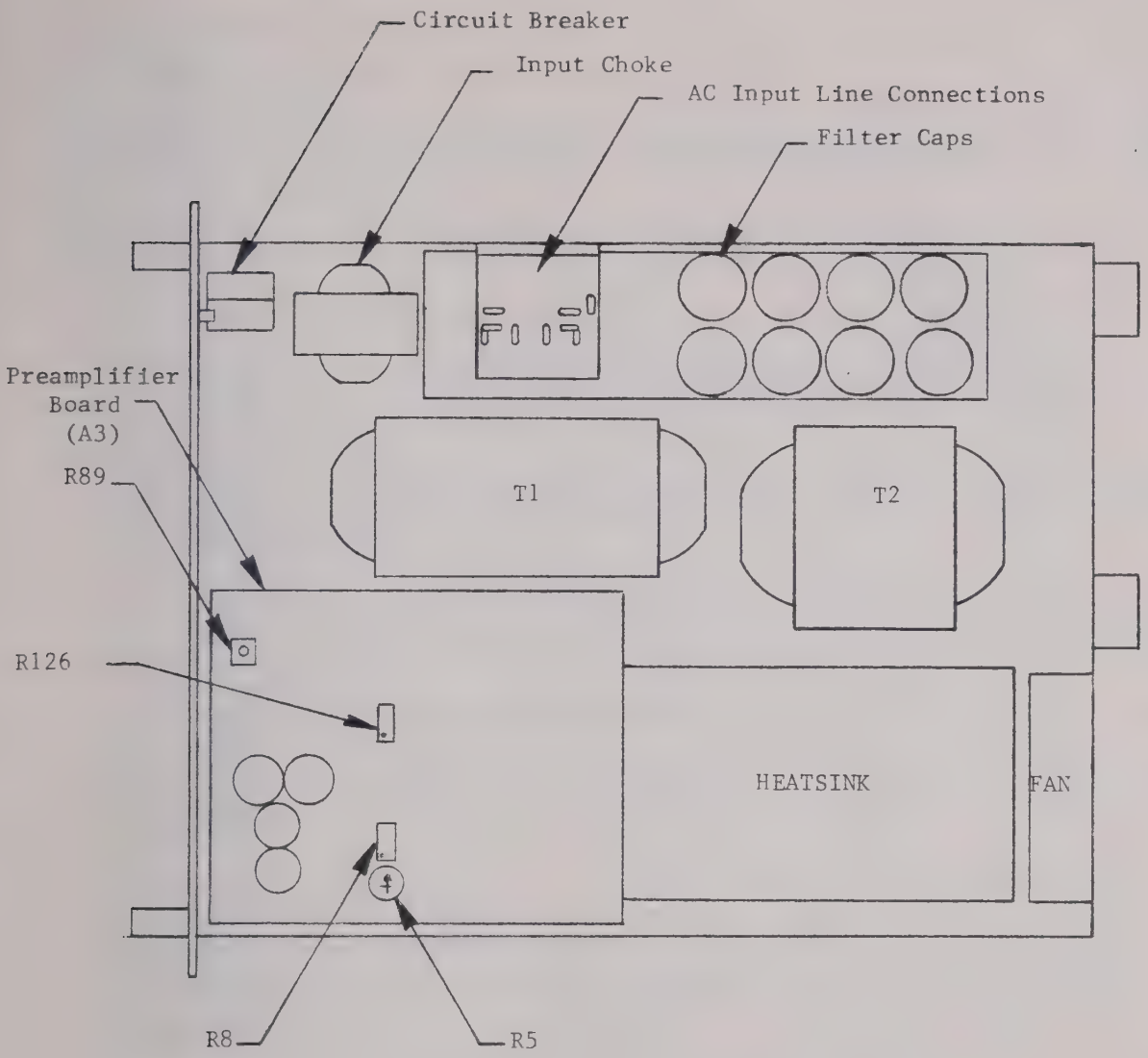


FIGURE 4-3.
LOCATION OF INTERNAL ADJUSTMENTS FOR XP-SERIES POWER SOURCE

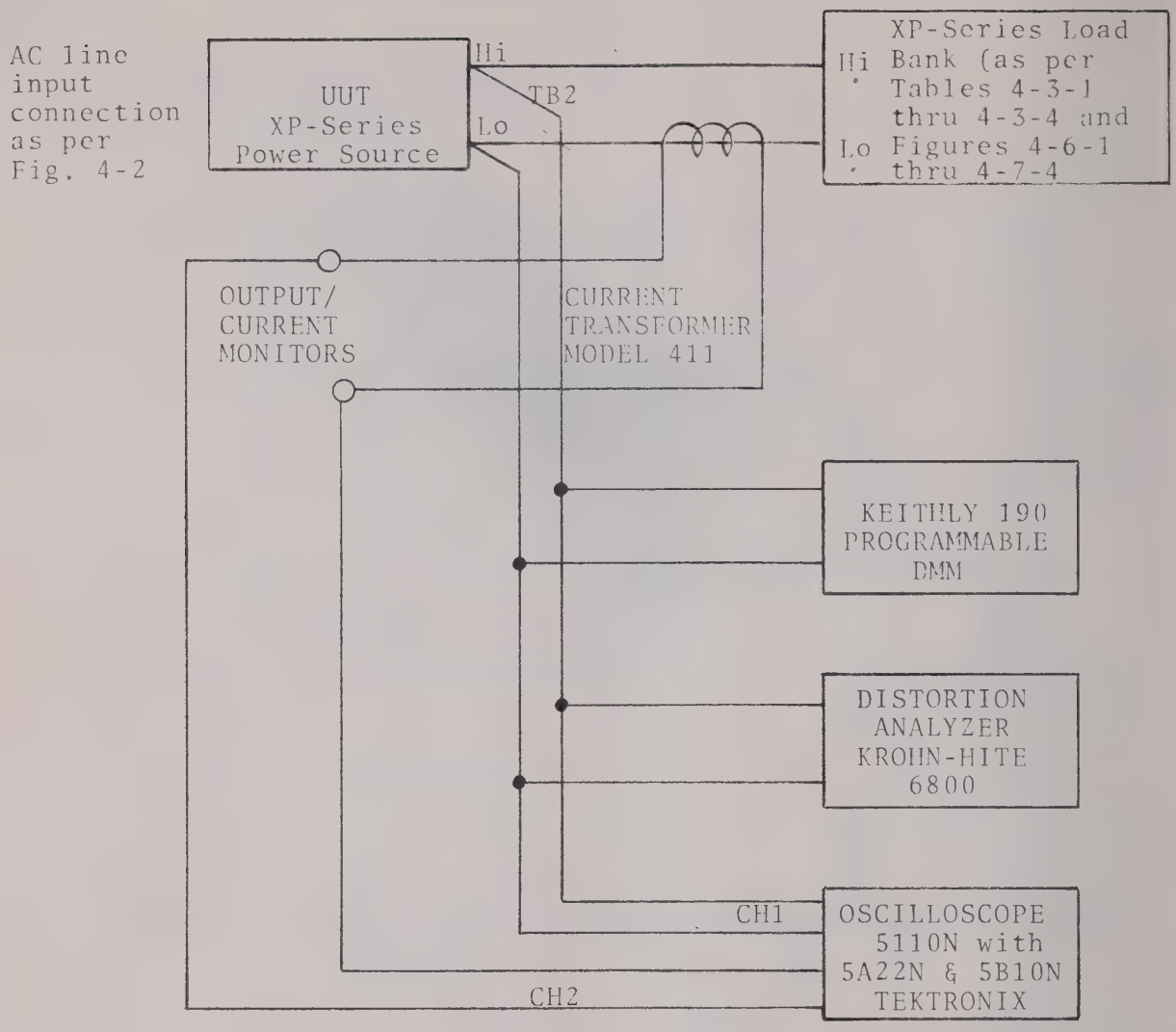


FIGURE 4-4 XP-SERIES TEST CIRCUIT CONNECTION DIAGRAM

4.6 POWER LIMIT TEST

The following test is used to check the operation of the XP series power protection circuits.

If not already accomplished, connect the power source and test equipment as per Figure 4-4.

1. Increase oscillator signal to 5 volts as measured at TP2.

2. Measure signal at TP1 with voltmeter. A reading of 37.8 volts rms indicates the gain of the power source is correct and requires no adjustment.

3. Adjust oscillator gain control to provide 105 volts output. All tests should be performed at 400 Hz 55 degrees C load.

4. Apply unity power factor load at 55 degrees C as per Tables 4-3-1A through 4-3-4A for the appropriate XP Series power source.

5. Measure the output at TP6 for a value of 5.43 volts rms ±2%.

6. Measure the output at TP8 for a value of 8.42 volts rms ±2%.

7. Apply a 55 degrees C .7 power factor load as per Figures 4-5B through 4-12B.

8. Measure output of TP8 for a value of 8.42 volts rms ±2%.

NOTE:

For the following tests, proper values of loads for 100% rated and 78% rated for the appropriate XP Series unit may be found in Table 4-3-1A through 4-3-4B.

4.7 MAXIMUM LOAD INPUT POWER TEST

The following tests are used to measure input power during maximum loads and worst case conditions.

If not already accomplished, connect the power source and test circuits per Figure 4-4.

Test Input power at 78% output voltage.

1. Adjust the autotransformer for 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP.

2. Turn unit "ON" and adjust GAIN control for 105 VAC output.

3. Apply proper load to the output (100% load at 78% output voltage). Readjust output voltage for 105 VAC if necessary.

4. Adjust autotransformer up to 135 VAC for low input range and 253 VAC for high input range. The power analyzer should indicate less than values in the Table 4-5.

5. Remove the load.

TABLE 4-5
INPUT POWER AT HIGH LINE AND FULL RATED OUTPUT

XP POWER SOURCE	INPUT POWER (WATTS) TA = 25 DEGREES C	TA = 55 DEGREES C
1301XP	3000	1950
971XP	2300	1420
651XP	1550	1010
321XP	770	500

4.8 LINE REGULATION TEST

The following steps may be used for testing response to changes in AC input line voltage.

If not already accomplished, connect the power source and test equipment per Figure 4-4.

NOTE

Care should be taken to ensure that the output amplitude of the oscillator remains stable and independent of line and load conditions during this test when using other than a California Instruments plug-in oscillator/power controller.

1. Set the autotransformer to 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP.

2. Turn unit "ON" and adjust output voltage to 135 VAC.

3. Apply proper load to the output (100% load at 100% output). Readjust output voltage for 135 VAC if necessary.

4. Vary the line input voltage from 90 to 135 VAC for low input range and from 207 to 253 VAC for high input range. Measure the change in the output voltage of the amplifier. This change should be less than .135 VAC.

5. Remove the load.

6. Repeat steps 1 through 5 at 45 Hz to 5 KHz. The output should change less than .135 VAC over the entire frequency range.

4.9 LOAD REGULATION ADJUSTMENT

NOTE

Care should be taken to ensure that the output amplitude of the oscillator remains stable and independent of line and load conditions during this test.

The following steps are used to minimize the output impedance of the power source.

If not already accomplished, connect the power source and test equipment per Figure 4-5.

1. Set the autotransformer to nominal input voltage of 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP.

2. Turn power source "ON".

3. Adjust output voltage to 105 VAC.

4. Apply proper load to the output (100% load at 78% output voltage).

5. Adjust the front panel REG control for 105 VAC ±10mV.

6. Remove the load.

7. Repeat steps 3 through 6 until the difference between the full load and no load voltage is less than 100 mVAC.

8. With regulation adjusted at 400 Hz, check the difference between load/no load voltage at 45 Hz to 5 KHz. Verify that the difference does not exceed 1% over the entire frequency range (1.1 VAC at 105 VAC output).

4.10 HARMONIC DISTORTION TEST

1. Set oscillator frequency to 400 Hz.

2. Adjust GAIN control for 105V rms output (78% of rated output) and apply proper load to the output (100% load at 78% rated output). Distortion should be less than 0.5%.

3. Vary the input voltage to the power source from 90 to 135 VAC for the low input range or 207 to 253 VAC for the high input range with the autotransformer. There should be no change in the signal waveform; distortion must remain less than 0.5%.

4. Remove the load.

5. Repeat Steps 1 through 4 at the following frequencies: 45 Hz and 5 KHz. Verify that the distortion does not exceed more than 0.5% over frequency range.

4.11 FREQUENCY RESPONSE TEST

The following steps are used to establish the frequency response of the power source over its operating frequency range.

If not already accomplished, connect power source and test circuits per Figure 4-4.

1. Adjust input line voltage to 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP. Set oscillator frequency to 400 Hz.

2. Turn unit "ON" and adjust GAIN control for 135 VAC.

3. Vary the output frequency of the oscillator from 45 Hz to 5 KHz and monitor the output voltage of the power source with a differential voltmeter under no-load conditions. The output of the power source should vary less than 7.55 volts rms from 45 Hz to 5 KHz.

4. Apply proper load to the output (100% load at 100% rated output). Again vary the frequency from 45 Hz to 5 KHz. The output voltage should vary less than 7.55 volts rms.

5. Remove the load.

4.12 AC NOISE LEVEL TEST

4.12.1 Peak-to-Peak Measurements

If not already accomplished, connect the power source and test circuits per Figure 4-4.

1. Adjust the autotransformer for 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP. Set the oscillator frequency to 400 Hz.

2. Turn unit "ON" and adjust the GAIN control for 105 VAC output.

3. Using the offset feature of the 5B10N plug-in, adjust the oscilloscope to observe the positive peak of the 105 VAC signal at .5 volt per centimeter sensitivity and a sweep rate of 5 milliseconds per cm.

4. Apply proper load for 78% rated unity power factor as per Tables 4-3-1B through 4-3-4B for the appropriate XP Series Power Source. The peak-to-peak noise and ripple should not exceed the values in Tables 4-3-1B through 4-3-4B depending on type of XP Series Power Source (60 dB below full output).

5. Remove the load. Turn power source "OFF", and remove the oscillator from the unit. Short the input to ground. Turn the power source back "ON" and verify that peak-to-peak noise level at output is less than the values in Tables 4-3-1 through 4-3-4 depending on type of XP Series Power Source.

4.12.2 RMS Measurements

1. With input still shorted, read the output voltage with a true rms voltmeter. The rms noise level should not exceed the values in Tables 4-3-1 through 4-3-4 depending on the type of XP Series Power Source.

2. Turn unit "OFF", remove the short from input and reinsert the oscillator in the XP Series Power Source.

3. Using a Hewlett Packard distortion analyzer, HP333A, set the analyzer reference to 0dB. Then proceed as in measuring distortion but read from dB scale. The reading should not exceed -60dB for any XP Series Power Source.

4.13 0.7 LAGGING POWER FACTOR TEST

The following steps are used to verify the ability of the power source to drive a 0.7 lagging power factor load. This represents the worst case inductive load for maximum power dissipation inside the power source. Select the proper load and temperature values for the power source from Figures 4-5A through 4-8B.

If not already accomplished, connect power source and test circuits per Figure 4-4.

1. Adjust the autotransformer for 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP.

2. Turn unit "ON" and adjust GAIN control for 105 VAC output.

3. Apply proper load to the output (0.7 lagging power factor at 78% rated output). Check that the power source maintains a stable output, with no high frequency oscillations. Verify distortion is less than .5%.

4. Remove the load.

4.14 0.7 LEADING POWER FACTOR TEST

The following steps are used to verify the ability of the power source to drive a 0.7 leading power factor load. This represents the worst case load for maximum power dissipation inside the power source. Select the proper loads and temperature values for the power source from Figures 4-9A through 4-12B.

If not already accomplished, connect the power source and test circuits per Figure 4-4.

1. Adjust the autotransformer for 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP. Set the oscillator to 400 Hz.

2. Turn unit "ON" and adjust the GAIN control for 105 VAC output.

3. Apply proper load to the output (0.7 leading power factor at 78% rated output). Check that the power source maintains a stable output with no high frequency oscillations. Verify that distortion is less than .5%.

4. Remove the load.

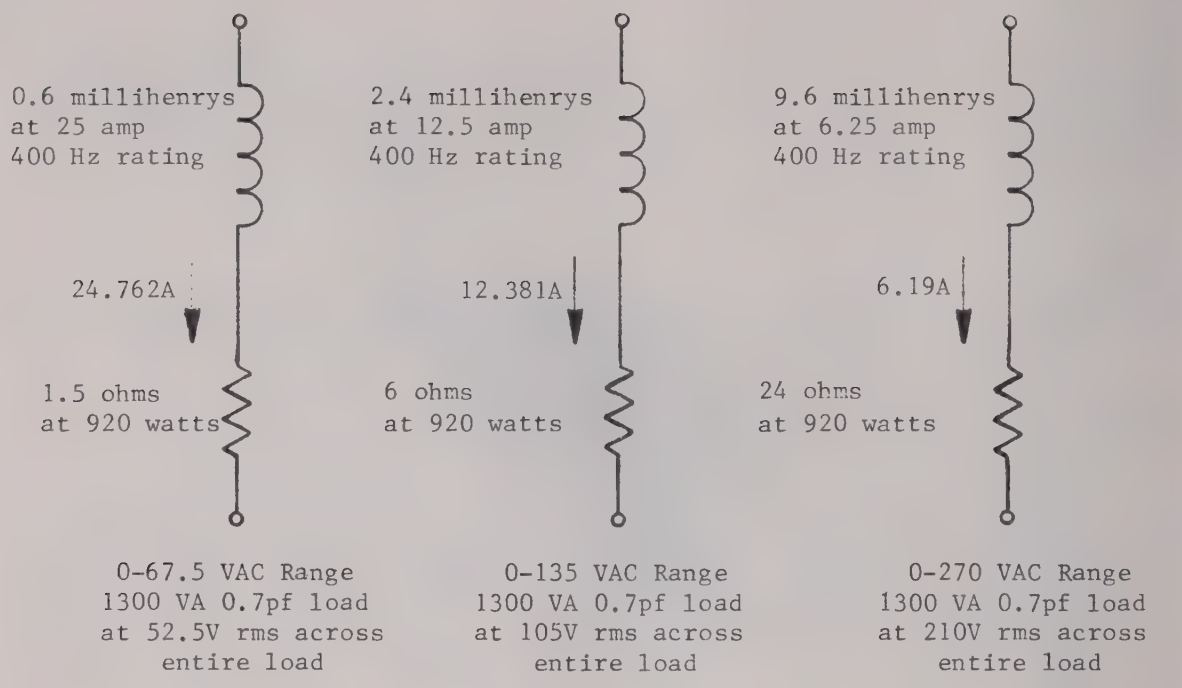


FIGURE 4.5A. Load Circuit for TA=25°C 0.7 Lagging Power Factor at 400 Hz.

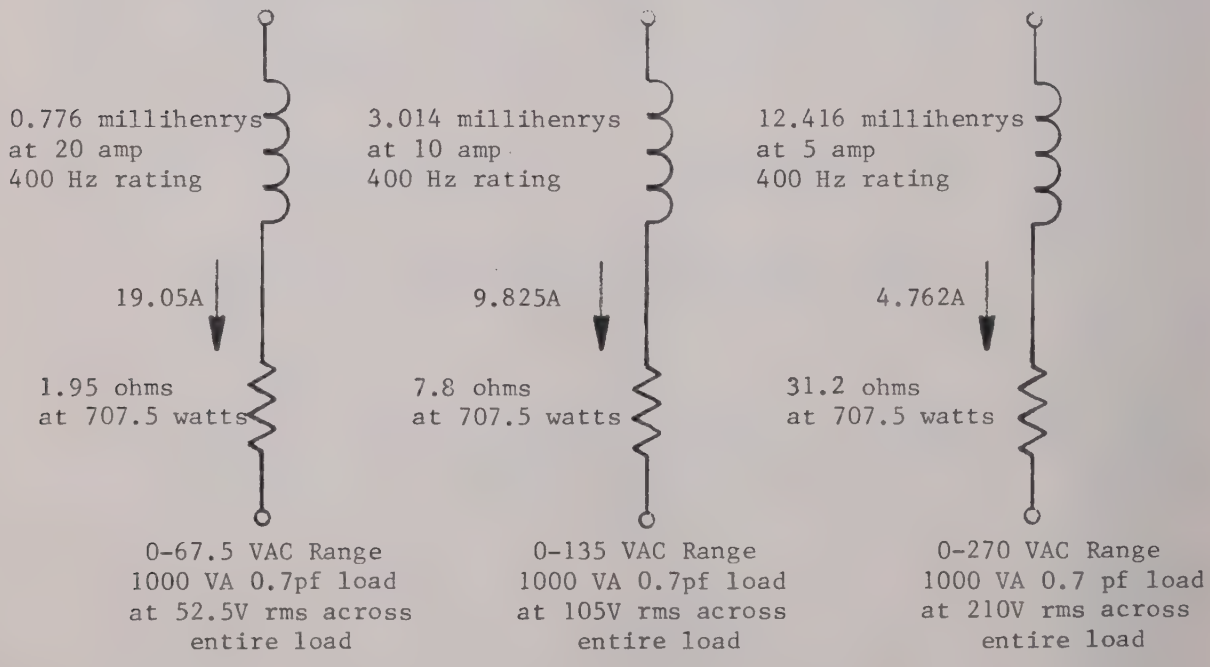


FIGURE 4.5B. Load Circuit for TA=55°C 0.7 Lagging Power Factor at 400 Hz.

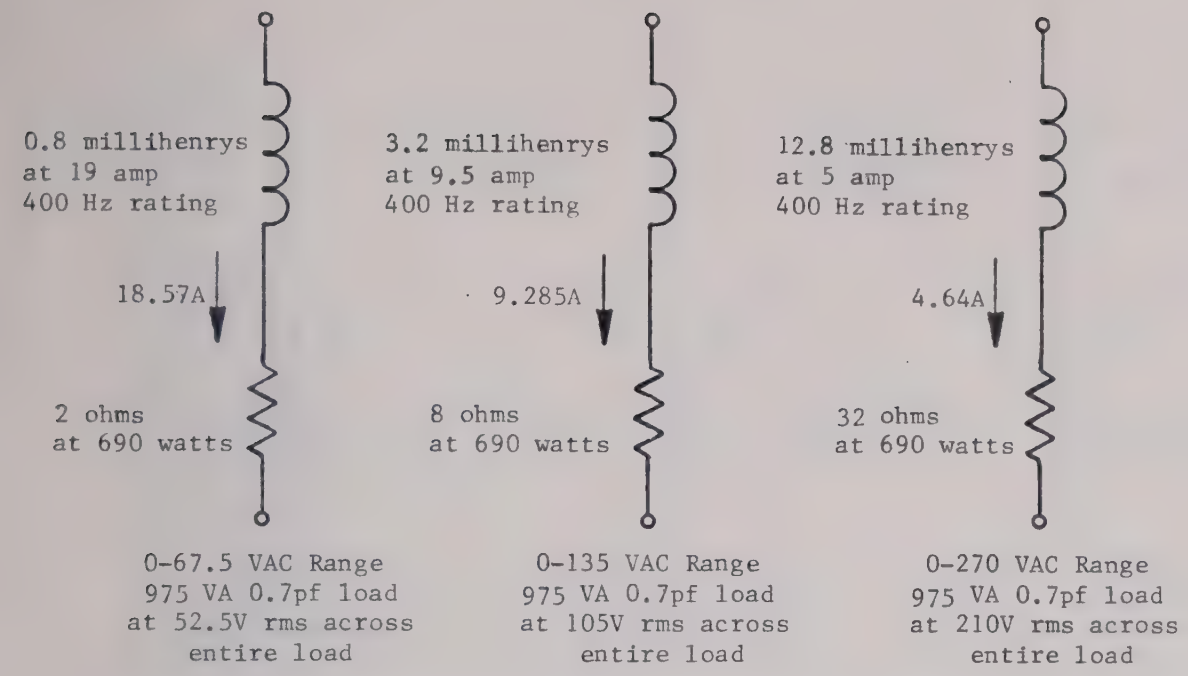


FIGURE 4.6A. Load Circuit for TA=25°C 0.7 Lagging Power Factor at 400 Hz.

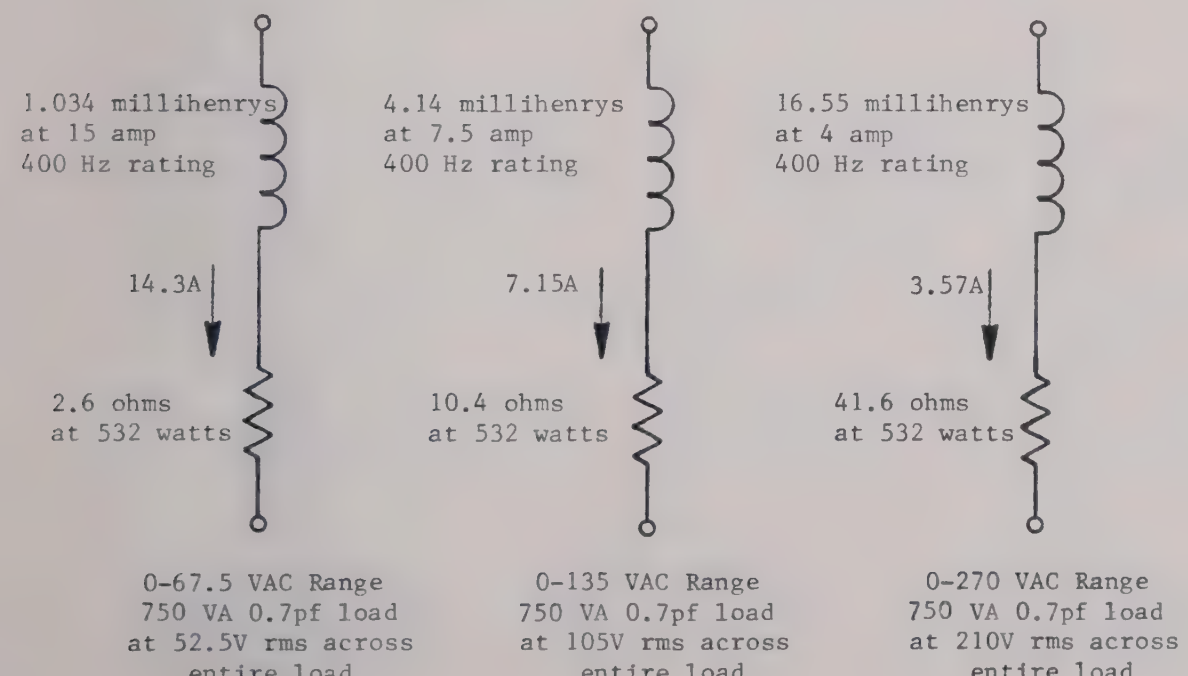


FIGURE 4.6B Load Circuit for TA=55°C 0.7 Lagging Power Factor at 400 Hz.

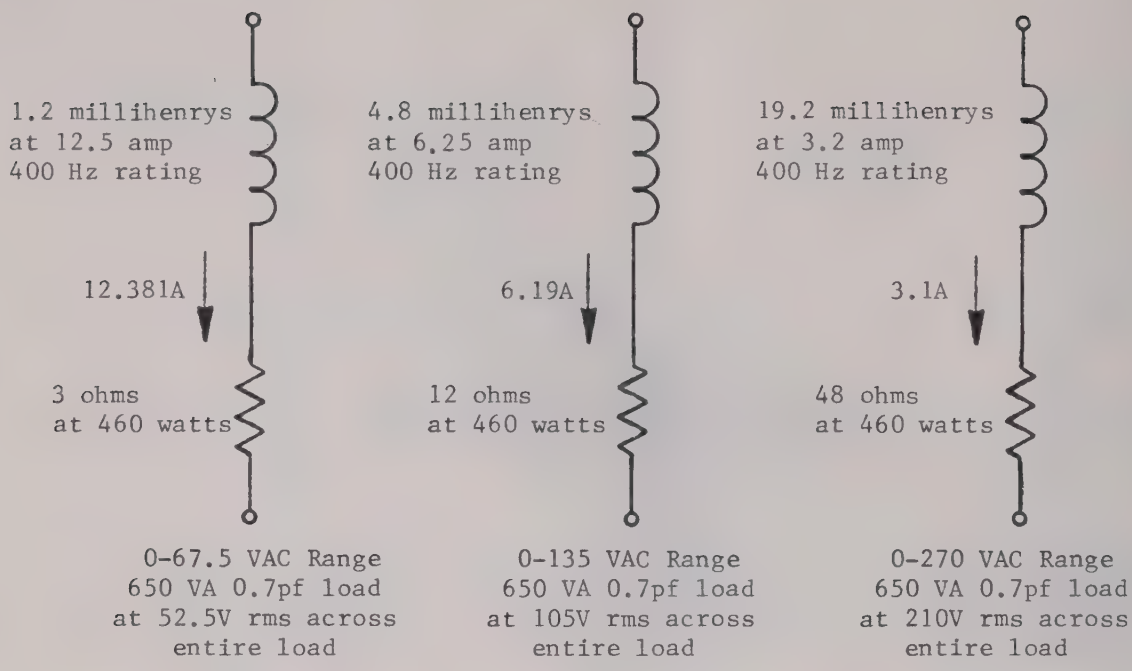


FIGURE 4.7A. Load Circuit for TA=25°C 0.7 Lagging Power Factor at 400 Hz.

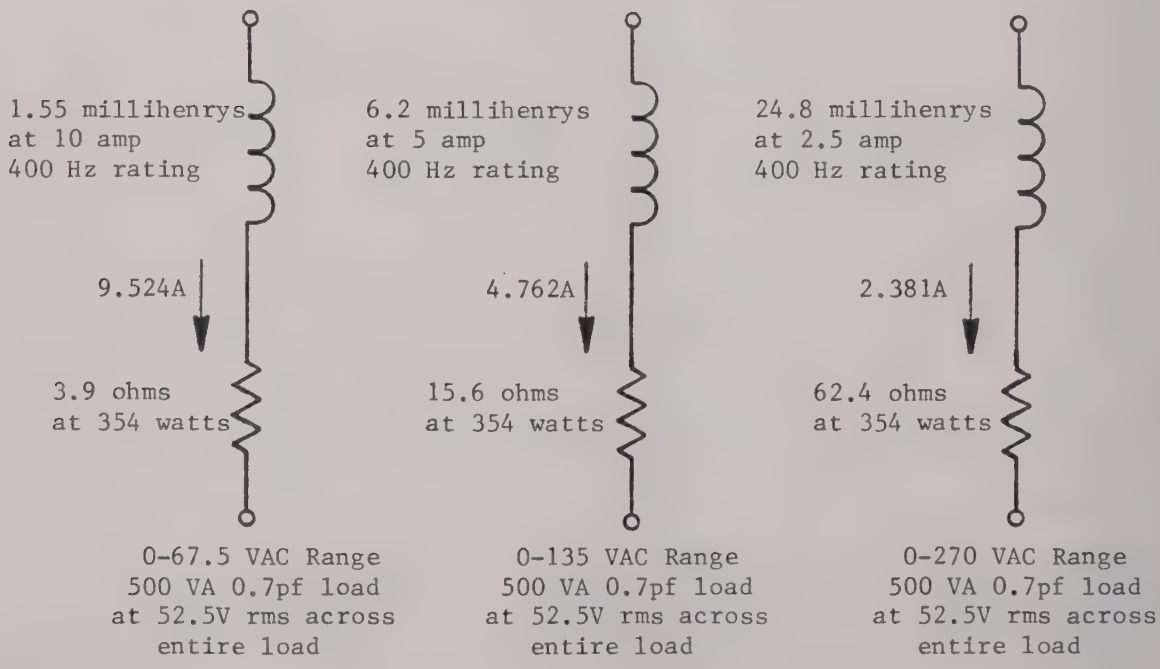
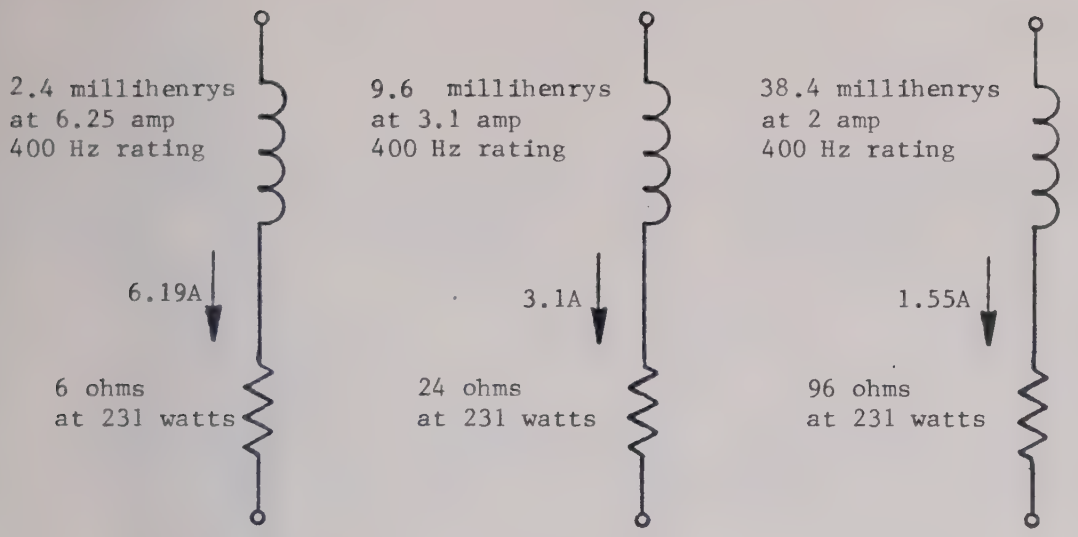


FIGURE 4.7B. Load Circuit for TA=55°C 0.7 Lagging Power Factor at 400 Hz.

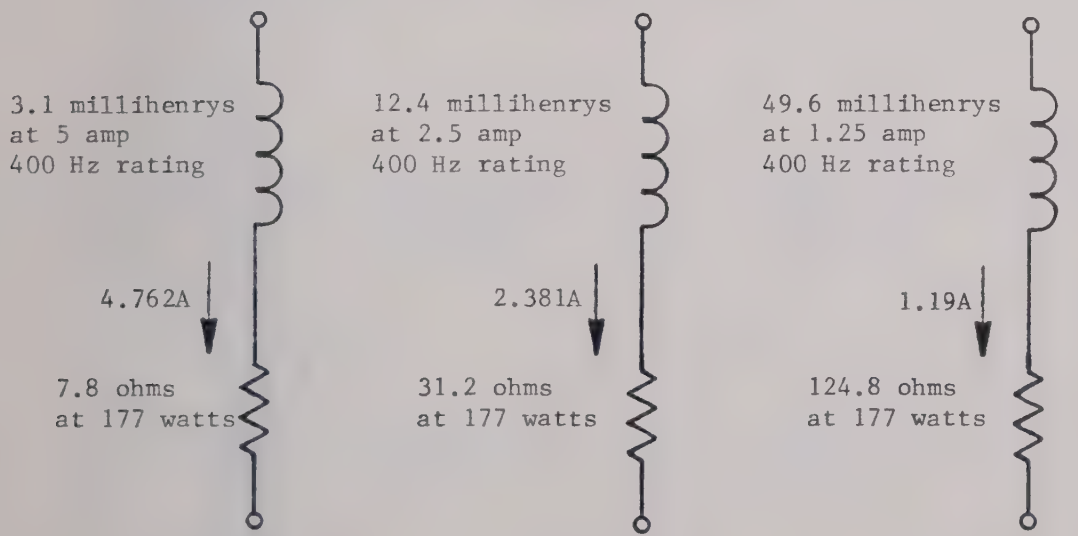


0-67.5 VAC Range
325 VA 0.7pf load
at 52.5V rms across
entire load

0-135 VAC Range
325 VA 0.7pf load
at 105V rms across
entire load

0-270 VAC Range
325 VA 0.7pf load
at 210V rms across
entire load

FIGURE 4.8A. Load Circuit for TA=25°C 0.7 Lagging Power Factor at 400 Hz.



0-67.5 VAC Range
250 VA 0.7pf load
at 52.5V rms across
entire load

0-135 VAC Range
250 VA 0.7pf load
at 105V rms across
entire load

0-270 VAC Range
250 VA 0.7pf load
at 210V rms across
entire load

FIGURE 4.8B Load Circuit for TA=55°C 0.7 Lagging Power Factor at 400 Hz.

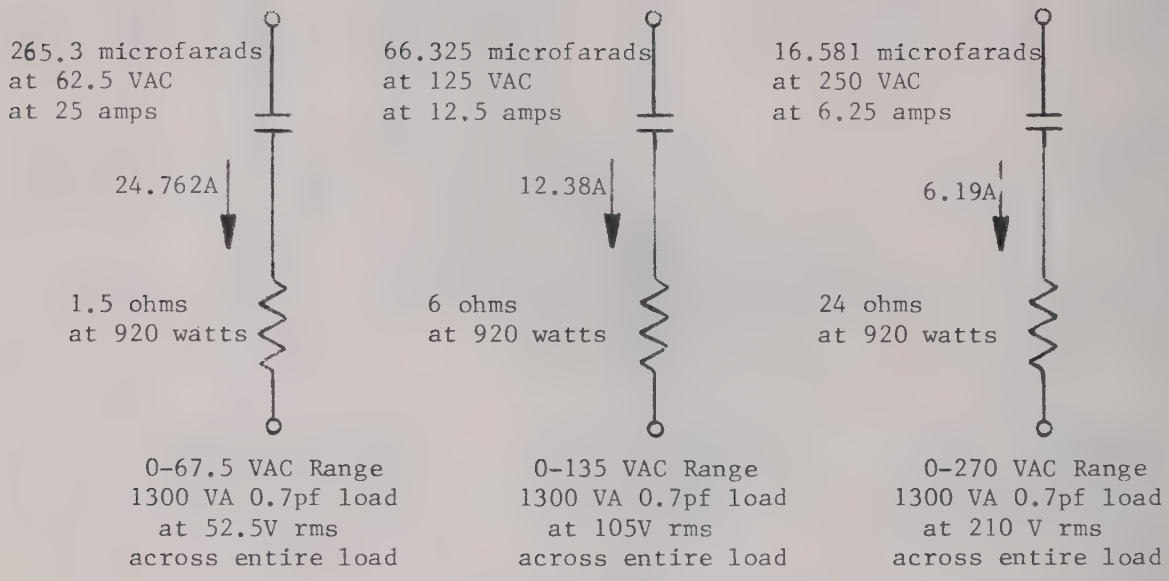


FIGURE 4.9A. Load Circuit for TA=25°C 0.7 Leading Power Factor at 400 Hz.

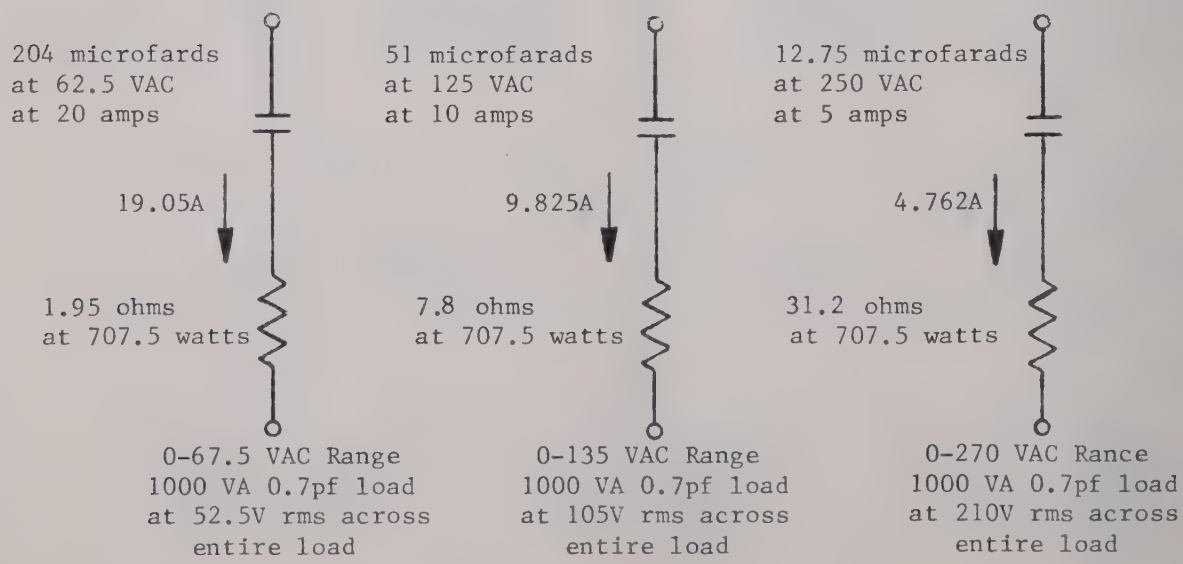


FIGURE 4.9B. Load Circuit for TA=55°C 0.7 Leading Power Factor at 400 Hz.

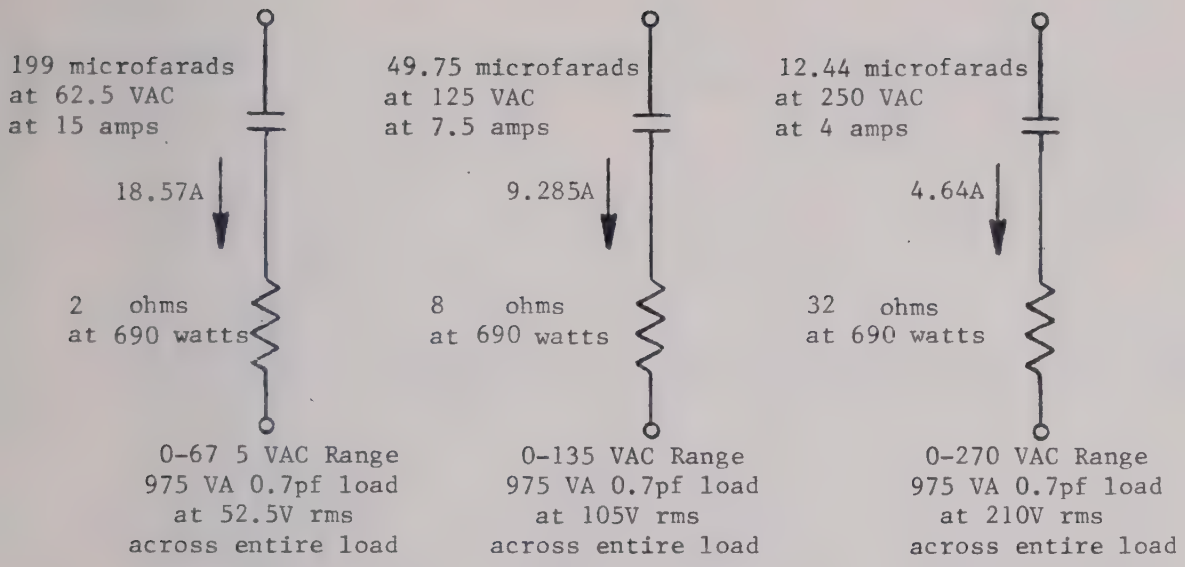


FIGURE 4-10A. Load Circuit for TA=25°C 0.7 Leading Power Factor at 400 Hz.

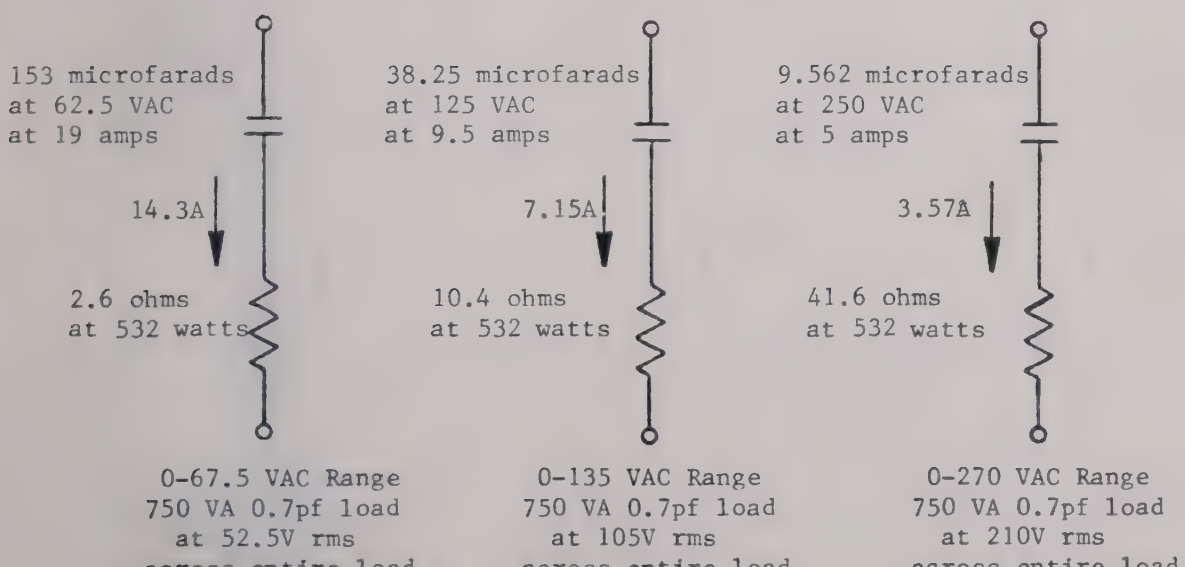


FIGURE 4.10B. Load Circuit for TA=55°C 0.7 Leading Power Factor at 400 Hz.

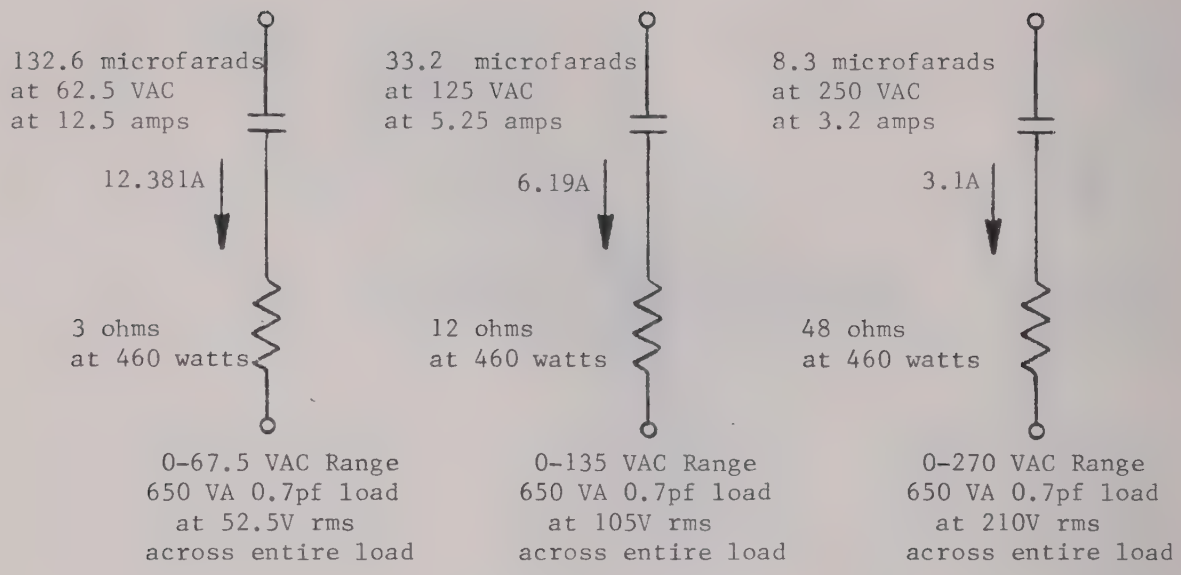


FIGURE 4.11A. Load Circuit for TA-25°C 0.7 Leading Power Factor at 400 Hz.

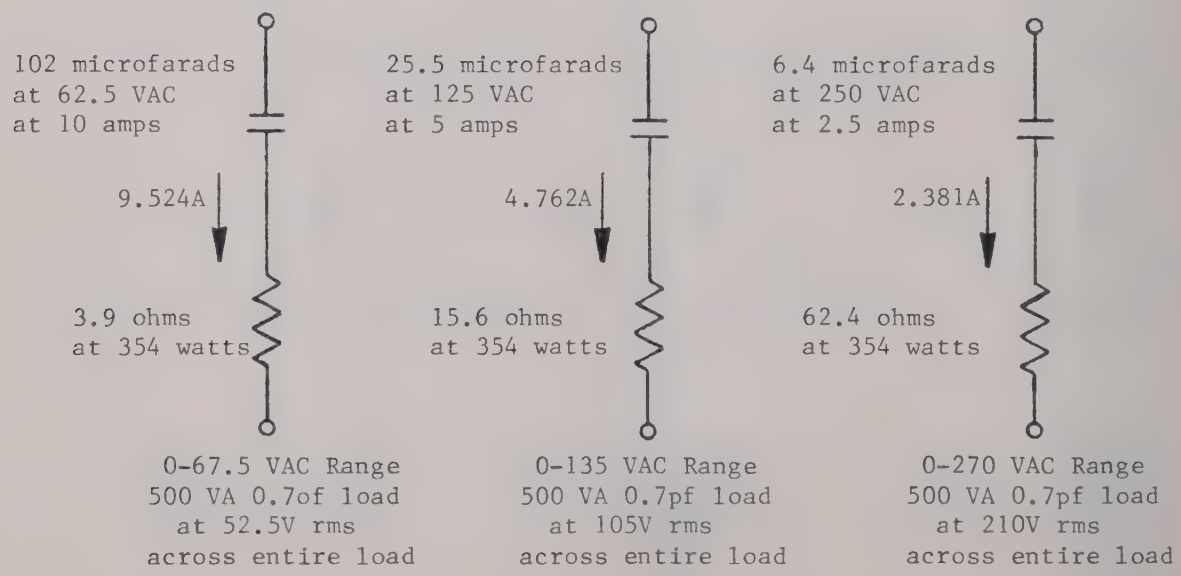
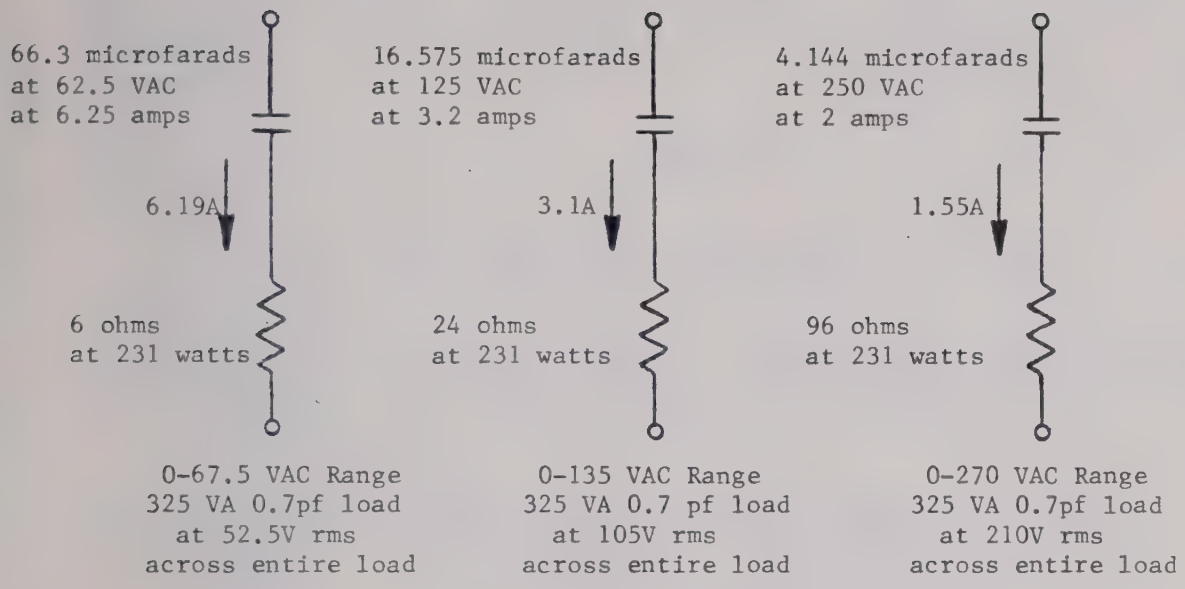


FIGURE 4.11B. Load Circuit for TA=55°C 0.7 Leading Power Factor at 400 Hz.

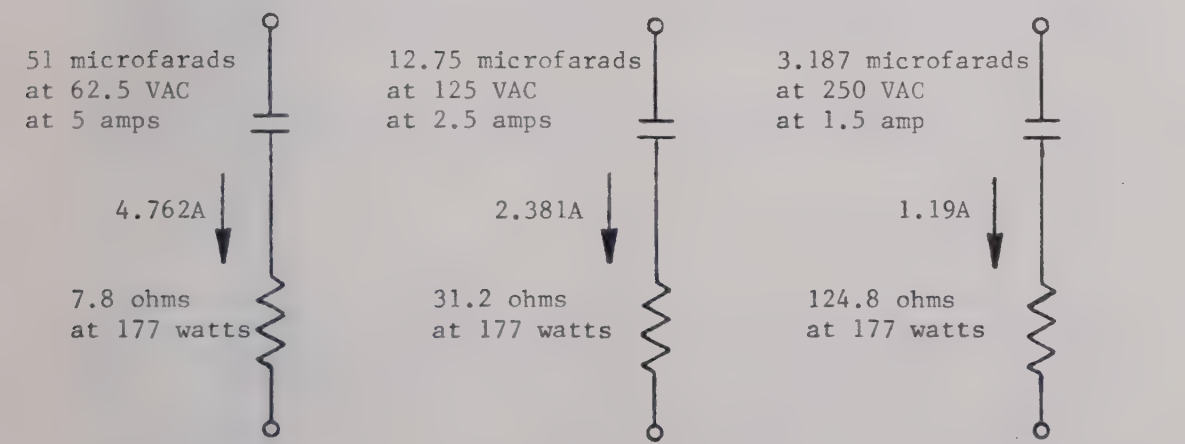


0-67.5 VAC Range
325 VA 0.7pf load
at 52.5V rms
across entire load

0-135 VAC Range
325 VA 0.7 pf load
at 105V rms
across entire load

0-270 VAC Range
325 VA 0.7pf load
at 210V rms
across entire load

FIGURE 4.12A. Load Circuit for TA=25°C 0.7 Leading Power Factor at 400 Hz.



0-67.5 VAC Range
250 VA 0.7pf load
at 52.5V rms
across entire load

0-135 VAC Range
250 VA 0.7pf load
at 105V rms
across entire load

0-270 VAC Range
250 VA 0.7pf load
at 210V rms
across entire load

FIGURE 4.12B. Load Circuit for TA=55°C 0.7 Leading Power Factor at 400 Hz.

4.15 PROGRAMMABLE CURRENT LIMIT TEST

The current limit test will verify the ability of the power source to limit the output if the output current exceeds the programmed values. Depending on the amount of overload, there will either be clipping on the positive and negative peaks of the output waveform or the output will be completely shut down. Tables 4-8-1 through 4-8-4 show the current values equivalent to the programmed values.

NOTE

The programmable current limit test can only be performed with an IMC Instrument Module installed.

If not already accomplished, connect the power source and test equipment as per Figure 4-4.

4.15.1 Test Current Limit

1. Adjust the autotransformer for 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP. Set oscillator frequency to 400 Hz.

2. Select the 135 VAC output range.

3. Set up the load assembly with the proper full power resistive load from Tables 4-7-1 through 4-7-4.

4. If a programmable oscillator/power controller is not available, apply proper DC programmed value as per Tables 4-8-1 through 4-8-4 to pin 4, J2, interface connector. Common connection is made to pin 15, J2.

5. Turn on the unit and adjust the output voltage to 105 VAC with the GAIN control on the oscillator/AC power controller.

6. Apply full load to the output.

7. With full scale current flowing, connect a 25% overload resistor in parallel with the load assembly. Tables 4-7-1 through 4-7-4 give the proper resistor values for the specific unit under test. With the 25% overcurrent load connected, the output waveform should show clipping on both positive and negative peaks.

8. Remove the overload resistor. The output voltage and 100% current should be restored.

4.15.2 Test Other Output Voltage Ranges and Frequencies

The above test procedures may be performed at other frequencies and current limit values. Tables 4-8-1 through 4-8-4 give peak current limit values and current limit programmed DC voltages.

4.16 OVERLOAD TEST

If not already accomplished, connect the power source and test equipment per Figure 4-4.

1. Set oscillator frequency to 400 Hz.
2. Turn the unit on and set the output voltage to 105 VAC.
3. Apply full resistive load to the output. Use Tables 4-7-1 through 4-7-4 for proper load values in different XP-Series power sources. The output waveform should be a clean sine wave.
4. With full scale current flowing, connect a 25% overload resistor in parallel with the load assembly. Tables 4-7-1 through 4-7-4 give the proper resistor values. With 25% overcurrent flowing, the output waveform should show clipping on both positive and negative peaks.
5. Remove the overload resistor. The output voltage and 100% current should be restored.
6. Apply a short circuit across the output.
7. Observe that output voltage waveform drops to zero on oscilloscope.
8. Observe that DS1 (green) is extinguished.
9. Remove short and observe that output ramps up to previous level.
10. Change frequency to 1 KHz.
11. Apply zero power factor load as per Table 4-6. The output waveform should remain a clean, undistorted sine wave.
12. With full scale current flowing at zero power factor, connect a 50% overload capacitor in parallel with the load assembly. See Table 4-6 for the proper capacitor value. With 50% overcurrent load at zero power factor, the output should drop to zero.
13. Observe that DS1 is extinguished.
14. Remove overload.

TABLE 4-6

CAPACITOR VALUES FOR ZERO POWER FACTOR LOAD AT f = 1 KHz

UNIT	CAP VALUE AT TA = 55 DEGREES C	CAP VALUE AT TA = 25 DEGREES C
1301XP	STANDARD: 7.7 uF 50% OVERLOAD: 3.8 uF	15.3 uF 7.7 uF
971XP	STANDARD: 5.8 uF 50% OVERLOAD: 2.9 uF	11.7 uF 5.8 uF
651XP	STANDARD: 3.8 uF 50% OVERLOAD: 1.9 uF	7.8 uF 3.9 uF
321XP	STANDARD: 1.9 uF 50% OVERLOAD: 1 uF	3.9 uF 0.5 uF

4.17 24 HOUR AMPLITUDE STABILITY TEST

If not already accomplished, connect the power source and test equipment per Figure 4-4.

1. Adjust the autotransformer to 115 VAC for the 321XP and 651XP or 230 VAC for the 971XP and 1301XP.

2. Turn unit "ON" and set output amplitude to 115 VAC.

3. Apply proper load to the output depending on XP Series Power Source and ambient temperature. Refer to Table 4-9. Check that the REG control has been set to provide zero regulation.

4. Connect an AC expanded scale (about 115 volts rms) strip chart recorder across the output terminals of the power source and record the drift during a 24 hour period. This drift should be less than ±0.29 volt rms. Disregard the drift during the first hour, as this represents initial warm-up drift. Care should be taken to ensure that the ambient temperature is held constant at ±3 degrees centigrade for this test.

TABLE 4-7-1 1301XP

LOAD VALUES FOR RATED OUTPUT AND OVERLOAD CONDITION

% OF RATED OUTPUT CURRENT AND % OVERLOAD VALUES	RESISTOR VALUES AT TA = 55 DEGREES C			RESISTOR VALUES AT TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	2.76	11.04	44.16	2.12	8.48	33.92
25% Overload	11.04	44.16	176.64	8.5	34	136
50%	5.52	22	88	4.24	17	68
25% Overload	22.1	88.4	353.6	17	68	272

NOTE: All resistors are in ohms

TABLE 4-7-2 971XP

LOAD VALUES FOR RATED OUTPUT AND OVERLOAD CONDITION

% OF RATED OUTPUT CURRENT AND % OVERLOAD VALUES	RESISTOR VALUES AT TA = 55 DEGREES C			RESISTOR VALUES AT TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	3.7	14.7	58.8	2.83	11.31	45.23
25% Overload	14.8	59.2	237	11.32	45.3	181.12
50%	7.4	29.4	117.6	5.66	22.62	90.56
25% Overload	29.6	118.4	473.6	22.64	90.56	362.24

NOTE: All resistors are in ohms

TABLE 4-7-3 651XP

LOAD VALUES FOR RATED OUTPUT AND OVERLOAD CONDITION

% OF RATED OUTPUT CURRENT AND % OVERLOAD VALUES	RESISTOR VALUES AT TA = 55 DEGREES C			RESISTOR VALUES AT TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	5.52	22	88.2	4.24	17	68
25% Overload	22.1	88.4	353.6	17	68	272
50%	11.04	44.16	176.64	8.5	34	136.7
25% Overload	44.16	176.64	707.2	34	136	544

NOTE: All resistors are in ohms

TABLE 4-7-4 321XP

LOAD VALUES FOR RATED OUTPUT AND OVERLOAD CONDITIONS

% OF RATED OUTPUT CURRENT AND % OVERLOAD VALUES	RESISTOR VALUES AT TA = 55 DEGREES C			RESISTOR VALUES AT TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	11.04	44.16	176.64	8.5	34	136
25% Overload	44.16	176.64	707.2	34	136	544
50%	22	88.2	352.2	17	68	272
25% Overload	88.4	353.6	1414.4	68	272	1088

NOTE: All resistors are in ohms

TABLE 4-8-1 1301XP

CURRENT LIMIT VALUES AND CURRENT LIMIT PROGRAMMED DC VOLTAGES

% OF RATED OUTPUT CURRENT	VOLTAGE RANGE TA = 55 DEGREES C			VOLTAGE RANGE TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	26.94A 2.63V	13.47A 1.32V	6.47A 0.63V	35A 3.42V	17.5A 1.71V	8.75A 0.85V
50%	13.47A 1.32V	6.74A 0.66V	3.37A 0.329V	17.5A 1.71V	8.75A 0.85V	4.4A 0.43V
10%	2.7A 0.264V	1.35A 0.132V	0.7A 0.068V	3.5A 0.342V	1.75A 0.171V	0.9A 0.088V

TABLE 4-8-2 971XP

CURRENT LIMIT VALUES AND CURRENT LIMIT PROGRAMMED DC VOLTAGES

% OF RATED OUTPUT CURRENT	VOLTAGE RANGE TA = 55 DEGREES C			VOLTAGE RANGE TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	20.21A 1.97V	10.1A 0.986V	5.05A 0.493V	26.26A 2.56V	13.13A 1.28V	6.56A 0.641V
50%	10.1A 0.986V	5.05A 0.493V	2.53A 0.247V	13.13A 1.28V	6.56A 0.641V	3.3A 0.322V
10%	2A 0.195V	1A 0.098V	0.5A 0.049V	2.63A 0.257V	1.31A 0.128V	0.66A 0.064V

TABLE 4-8-3 651XP

CURRENT LIMIT VALUES AND CURRENT LIMIT PROGRAMMED DC VOLTAGES

% OF RATED OUTPUT CURRENT	VOLTAGE RANGE TA = 55 DEGREES C			VOLTAGE RANGE TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	13.47A 1.315V	6.74A 0.658V	3.37A 0.329V	17.5A 1.71V	8.75A 0.854V	4.4A 0.429V
50%	6.74A 0.658V	3.37A 0.329V	1.7A 0.166V	8.75A 0.854V	4.4A 0.429V	2.2A 0.215V
10%	0.135A 0.013V	0.7A 0.068V	0.34A 0.033V	1.75A 0.171V	0.9A 0.088V	0.44A 0.043V

TABLE 4-8-4 321XP

CURRENT LIMIT VALUES AND CURRENT LIMIT PROGRAMMED DC VOLTAGES

% OF RATED OUTPUT CURRENT	VOLTAGE RANGE TA = 55 DEGREES C			VOLTAGE RANGE TA = 25 DEGREES C		
	52.5VAC	105VAC	210VAC	52.5VAC	105VAC	210VAC
100%	6.74A 0.658V	3.37A 0.329V	1.7A 0.166V	8.75A 0.854V	4.4A 0.429V	2.2A 0.215V
50%	3.37A 0.329V	1.7A 0.166V	0.85A 0.083V	4.4A 0.429V	2.2A 0.215A	1.1A 0.107V
10%	0.7A 0.068V	0.34A 0.033V	0.17A 0.017V	0.9A 0.088V	0.44A 0.043V	0.22A 0.021V

TABLE 4-9
LOAD VALUES FOR 115 VAC OUTPUT

UNIT	TA = 55 DEGREES C	TA = 25 DEGREES C
1301XP	8.7 ohms	11.304 ohms
971XP	6.521 ohms	8.48 ohms
651XP	4.348 ohms	5.652 ohms
321XP	2.174 ohms	2.826 ohms

WARNING

HIGH VOLTAGE (270 VAC)

Voltages up to 270 VAC are available in certain sections of this power source. This equipment generates potentially lethal voltages.

DEATH

On contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with the primary power circuits, and the output circuits of the power source.

SECTION V

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL

The California Instruments XP Series AC Power Sources are solid state units and should require a minimum of maintenance. However, they are force air-cooled and will accumulate some dust with time. The power transistor heatsinks should receive a forced air bath at intervals not to exceed six months.

Heatsink Cleaning:

CAUTION

Failure to keep the heatsinks clean will reduce their thermal efficiency and could cause failure of the power source.

1. Make sure unit is "OFF".
2. Remove top cover of unit and top cover of heatsink wind tunnel.
3. Slide inboard side of wind tunnel up and out of its slot.
4. Unplug and remove heatsinks.
5. Blow heatsinks clean with compressed air from inside toward outside of convoluted fin sections.

5.2 TROUBLESHOOTING

5.2.1 External Checks

If the problem appears to be in the power source, it may be isolated to a specific section of the unit. Before removing the covers, check that the AC power input to the unit is of the proper amplitude and frequency. Check that the signal input to the power source is also of the proper amplitude (5 volts rms) and frequency (45 Hz to 5 KHz) by observing the output at TP2 with an oscilloscope. Check that the output load on the power source is not excessive or that the load starting transients are not excessive. Refer to Tables 2-3-1 through 2-3-4 for proper load values at a specific voltage and for a specific unit.

5.2.2 Check DC Power Supply

Check all DC power supply voltages. Information concerning power supplies is given in Paragraph 3.2.11, 3.2.12 and 4.4 of this instruction manual. If there is a problem with ±15 volts, the preamplifier would stay off until the supplies come up.

5.2.3 Check Power Amplifier Output.

Check that the quasi-complementary symmetry output amplifier is operating properly and is not drawing excessive current under zero load conditions. Section III of this instruction manual describes the operation of the power amplifier.

5.2.4 Check Preamplifier Output

If the output of the amplifier does not appear correct, disconnect the output transformer and apply a small load to the output of the power amplifier. If the output of the amplifier still does not appear correct, disconnect the preamplifier from the power amplifier and close the feedback loop around the preamplifier. If the output of the preamplifier appears correct, then the problem is within the power amplfier and must be corrected. However, if the output of the preamplifier does not appear correct, then check the following: 1) The transistors in the level shifter and the biasing level to the level shifter; 2) TP7 for the proper amplitude sine wave.

5.2.5 Check Fault Circuits

Check that the fault circuits are operating properly. The fault circuits consist of the temperature sense circuit, the short and overload circuit and the overpower circuit. If any of these circuits does not operate properly, the complete self-protection capability of the power source would be diminished.

5.2.5.1 Temperature Sense Circuit

Check the common cathode connection of CR15 and CR16. The voltage at that point should be 6.42 VDC ±3% at TA = 25 degrees C and should be 0 at TA = 55 degrees C. Check the heatsinks temperature to be about 98 degrees C at TA = 55 degrees C and about 81 degrees C at TA = 25 degrees C. Temperature sense circuit may be disabled by removing diodes CR15 and CR16.

5.2.5.2 Overload Circuit

Read the voltage at TP6. It should be 7.07 volts rms at TA=25 degrees C and 5.423 volts rms at TA=55 degrees C at 78% rated output and 0.7 power factor load. Refer to Figures 4-5A to 4-12B for proper load values. The overload circuit may be disabled by removing A3R116.

5.2.5.3 Overpower Circuit

Read the voltage at TP8. It should be 8.42 volts DC ±2% at full rated output. It will stay 8.42 volts up to 78% rated output and 0.7 power factor load. Apply zero power factor load. The voltage at TP8 should drop to 2.5 volts DC. Check the inputs to U6 comparator. The inputs should be sine wave signals. The output of U8 should be a pulsed signal. The duration of pulses is dependent on output power factor. The overpower circuit may be disabled by removing A3R39.

5.2.6 Check Plug-In Oscillator/Power Controller

If the problem has been isolated to the oscillator/power controller, consult the proper oscillator/power controller manual.

5.2.7 Check Instrument Module.

If the problem has been isolated to the instrument module, consult the proper instrument module manual.

SECTION VI

CIRCUIT DIAGRAMS

6.1 GENERAL

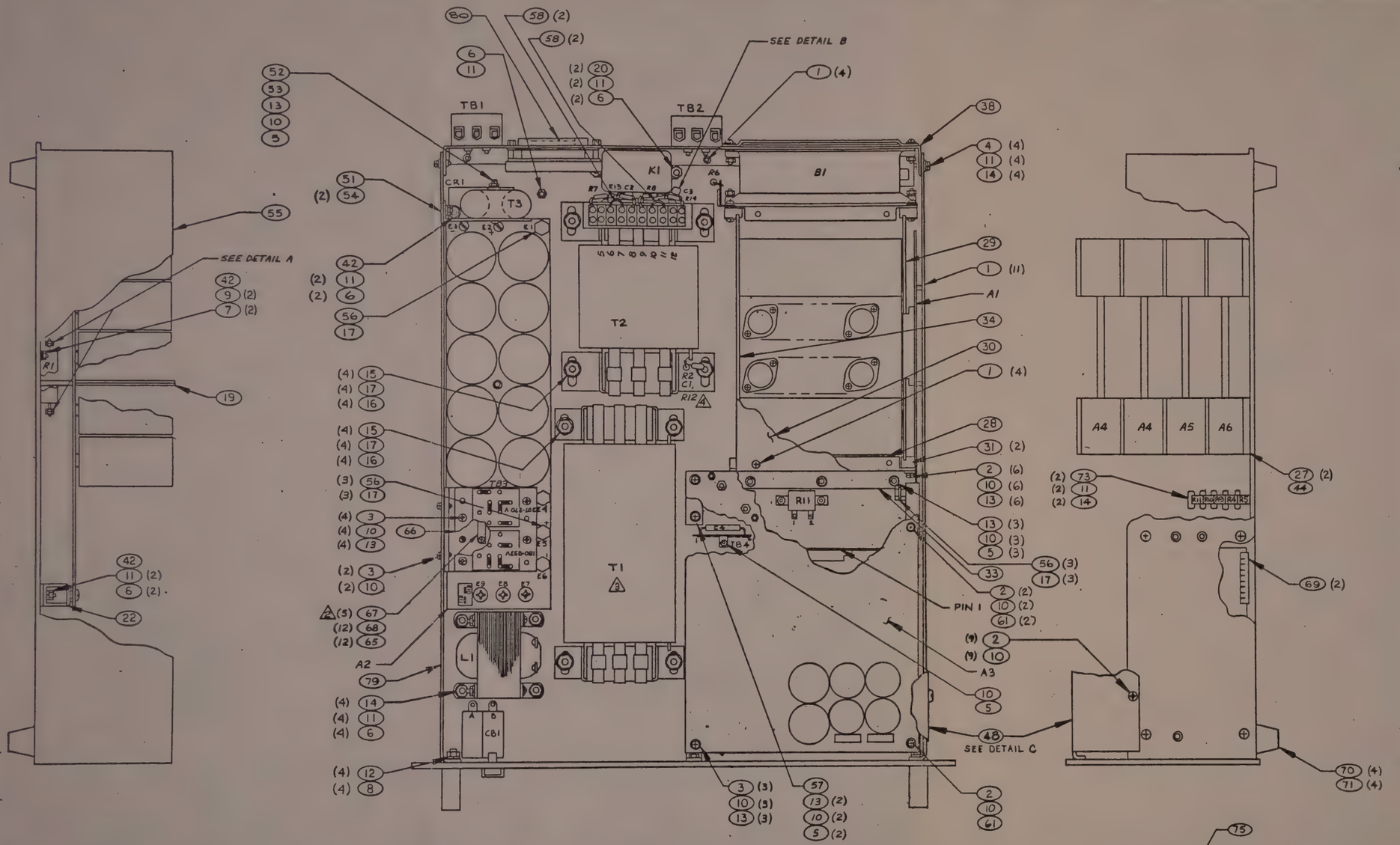
This section contains schematics and mechanical diagrams necessary for operation and maintenance of the XP Series Power Sources. The schematic diagrams illustrate the circuit while the mechanical assemblies indicate the part placement.

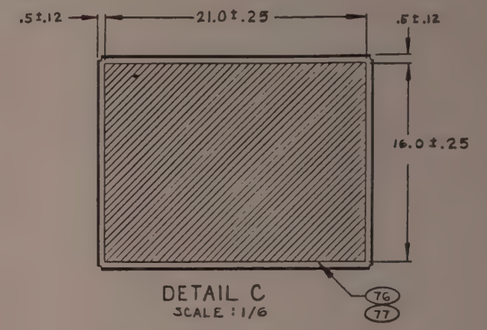
6.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on the schematic and mechanical drawings. To determine the complete reference designator, prefix the schematic or drawing reference designator with the assembly and/or sub-assembly designator. For example:

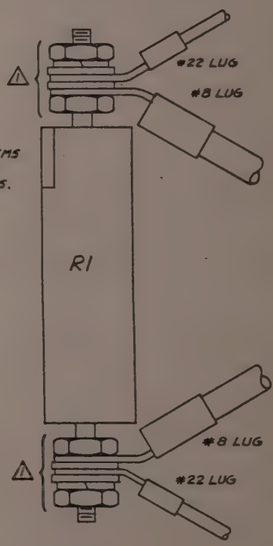
Assembly/Sub-Assembly	Component	Component Designation
A1	C8	A1C8
None	T1	T1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADD A5 MTG HARDWARE. ADD TB3 HDWE	9/84	
B	ADDED R12 NEAR T2, NOTE 4, DETAIL B, R7,8,13,14	10/85	





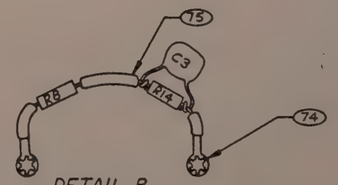
DETAIL C
SCALE : 1/6



DETAIL A
SCALE: 2/1

⚠ ATTACH THE FOLLOWING ITEMS TO THE RESISTOR STUD IN THE ORDER SHOWN, TYP BOTH STUDS.

1. 8-32 BRASS NUT (60)
2. #8 LUG (HARNESS)
3. #8 FIBRE WASHER (59)
4. #22 LUG (HARNESS)
5. #8 FLAT WSHR (14)
6. #8 SPLT L'WSHR (11)
7. 8-32 BRASS NUT (60)



DETAIL B
TYP FOR R7, C2, R13

FOR PARTS LIST SEE 4000-409-1, -2, -3, -4

⚠4 WRAP C1 LEADS AROUND R12 LEADS AND SOLDER. USE R12 LEADS FOR CONNECTIONS TO T2-1,3. IF USED, SIMILARLY WRAP AND SOLDER C2, C3 LEADS AROUND R13, R14 LEADS, RESPECTIVELY.

⚠3 INSULATE T1-1 THRU T1-6 USING ITEM 78 AFTER SOLDERING WIRES IN PLACE.

⚠2 FASTEN ITEM 67 PER 207-270V DIAGRAM

⚠1 SEE DETAIL A INSTRUCTIONS FOR R1 HDWE ASSY

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
	1301XP	END ITEM

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT.	NOTE NO.

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √

DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

TITLE: TOP ASSY

			ADDITIONAL APPROVALS
RELEASE	P. Bedyak	3/25/85	
PROJ ENG	J ROUSE	3-22-85	
CHECK	ERWINE	3/25/85	
DESIGN			
DRAFT	RICE	10-15-84	3/25

California Instruments
A DIVISION OF AMTAR TECHNICAL PRODUCTS CO., INC
SAN DIEGO, CALIFORNIA

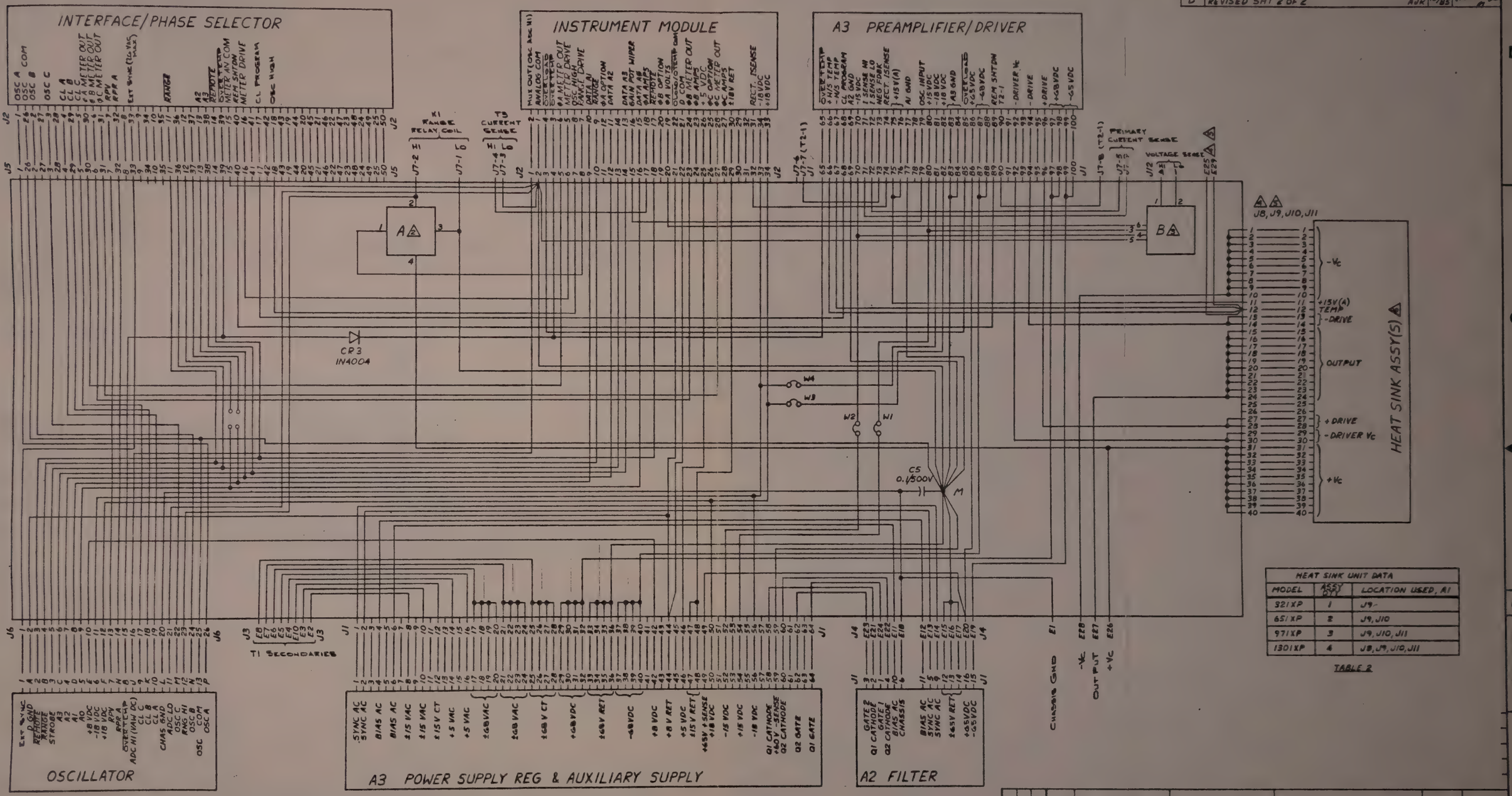
CONTRACT NO. — CODE IDENT 16067

DWG NO 4000-409 REV B

SCALE 1 : 2 SHEET 1 OF 1

4000-409 B

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
B	REVISED AND REDRAWN, SEE OBS DWG FILE	8.1.85	
C	REVISED SHEET 2	9.85	
D	REVISED SHT 2 OF 2 AJR	10/85	



NOTES CONTINUED ON SHT 2

A FOR HEAT SINK ASSY QTY & LOCATION(S), SEE TABLE 2.

B CONNECTIONS TO PIN 12 SHOWN ARE A COMPOSITE OF CONNECTIONS TO J8, J9, J10, J11. SEE TABLE 1 FOR ACTUAL CONNECTIONS.

C J8 & E29 EXIST ONLY ON MOTHER PC ASSY OF 1301XP.

D SEE SHEET 2 FOR DETAIL OF VOLTAGE SENSOR CIRCUIT B.

E SEE SHEET 2 FOR DETAIL OF RELAY SWITCH CIRCUIT A.

1. FOR WIRE TAB TABLE, SEE WTT 4000-050

NOTES: (UNLESS OTHERWISE SPECIFIED)

HEAT SINK UNIT DATA		
MODEL	ASSY QTY	LOCATION USED, A1
321XP	1	J9
651XP	2	J9, J10
971XP	3	J9, J10, J11
1301XP	4	J8, J9, J10, J11

TABLE 2

TEMP SENSING DATA		
FROM	TO	DESCRIPTION
J8-12	E29	SPARE +TEMP
J9-12	J1-66	+H/S TEMP
J10-12	J1-67	-H/S TEMP
J11-12	E25	SPARE -TEMP

TABLE 1

QTY REQD	USED ON	NEXT ASSY
	1301XP	
	971XP	
	651XP	
	321XP	

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT.	NOTE NO.

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 .XX ± .03 X° ± 30' BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓

DWG SIZE D

TITLE SCHEMATIC

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

			ADDITIONAL APPROVALS
RELEASE	A. Roberto	9/25/85	
PROJ ENG	J. ROUSE	3-22-85	
CHECK	E. WINE	9/26/85	
DESIGN			
DRAFT	A. ROBERTO	9/26/85	

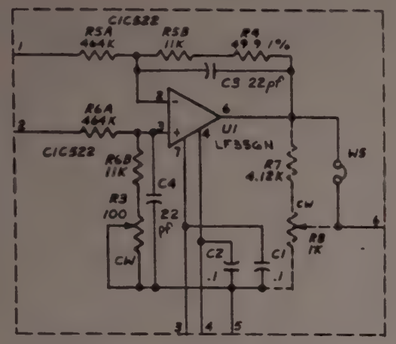
California Instruments
A DIVISION OF AMETEK TECHNICAL MATERIALS CO. INC. SAN DIEGO CA

CONTRACT NO | CODE IDENT 04047

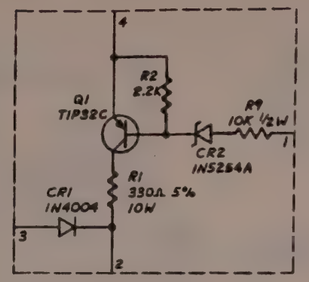
DWG NO 4000-088 | REV D

SCALE | SHEET 2

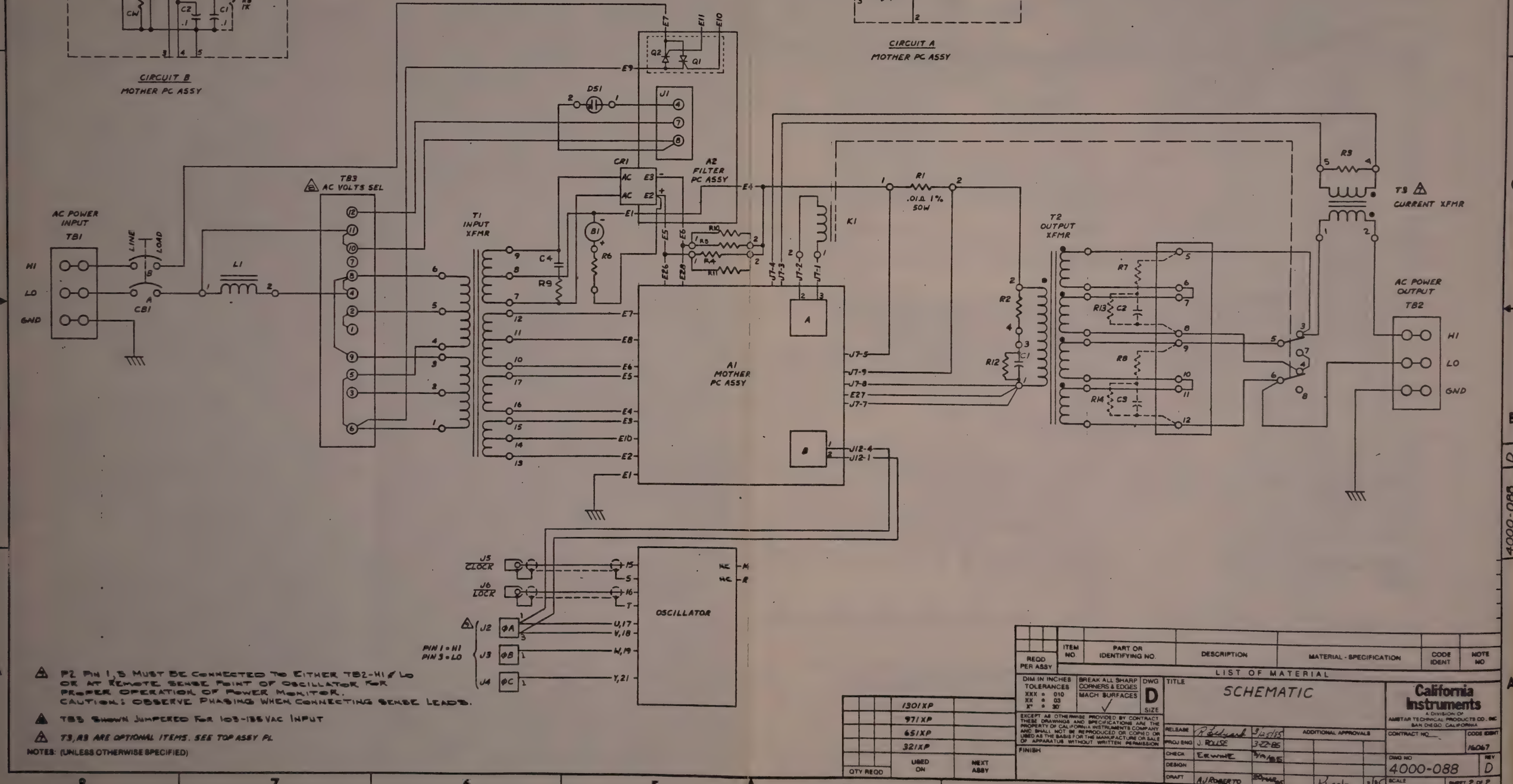
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADDED CR2 & R9. REV T3. ADDED B1. R6,7,8,9, C2,3,4	2/3 LTR 8/5	AJR
B	REVISED NOMENCLATURE	7/65	
C	REVISED J2 HOOK-UP	9/65	
D	ADDED R12, R13, R14 AJR	10/85	J.K. 12-5-85



CIRCUIT B
MOTHER PC ASSY



CIRCUIT A
MOTHER PC ASSY



⚠ P2 PIN 1,3 MUST BE CONNECTED TO EITHER TB2-HI & LO OR AT REMOTE SENSE POINT OF OSCILLATOR FOR PROPER OPERATION OF POWER MONITOR.
CAUTION: OBSERVE PHASING WHEN CONNECTING SENSE LEADS.

⚠ TB3 SHOWN JUMPERED FOR 103-135 VAC INPUT

⚠ T3, A3 ARE OPTIONAL ITEMS. SEE TOP ASSY PL

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
	1301XP	
	971XP	
	651XP	
	321XP	

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE: SCHEMATIC

			ADDITIONAL APPROVALS
RELEASE	R Eckhardt	3/25/85	
PROJ ENG	J. ROUSE	3-22-85	
CHECK	E. WHITE	3/25/85	
DESIGN			
DRAFT	A.J. ROBERTO	3/25/85	

California Instruments
A DIVISION OF AMBAR TECHNICAL PRODUCTS CO., INC
SAN DIEGO, CALIFORNIA

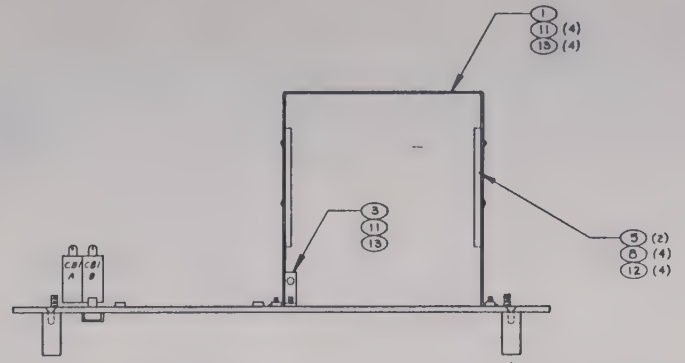
CONTRACT NO. | CODE IDENT 16067

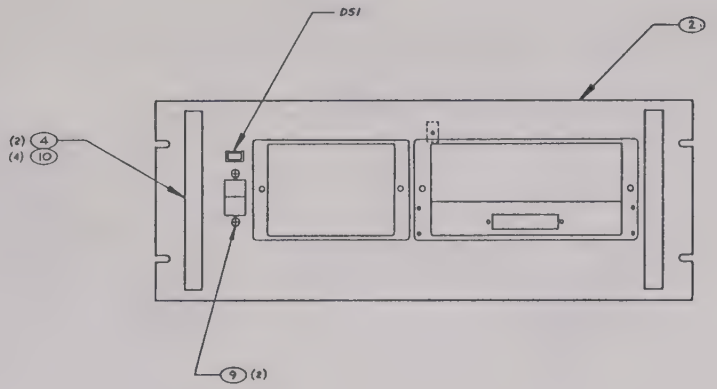
DWG NO 4000-088 | REV D

SCALE | SHEET 2 OF 2

4000-088 D

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	INCORPORATE 9715P AS -2	A/R	
B	REVISED CBI CIRCUIT BREAKER		





FOR PARTS LIST SEE 4000-404-1,-2

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
		-2 FRONT PANEL ASSY			
		-1 FRONT PANEL ASSY			

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010, XX ± .03, X° ± 30. BREAK ALL SHARP CORNERS & EDGES. MACH SURFACES. DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE: FRONT PANEL ASSY

California Instruments, A DIVISION OF AMETEK TECHNICAL PRODUCTS CO INC, SAN DIEGO CALIFORNIA

RELEASE		3/25/85	ADDITIONAL APPROVALS
PROJ ENG	J LUKE	3-22-85	
CHECK	A/ROGERS	3/26/85	ENGINEER 3/27
DESIGN			
DRAFT	R. GERVAIS	10-15-84	3/28

CONTRACT NO — CODE IDENT 16067

DWG NO 4000-404 — REV B

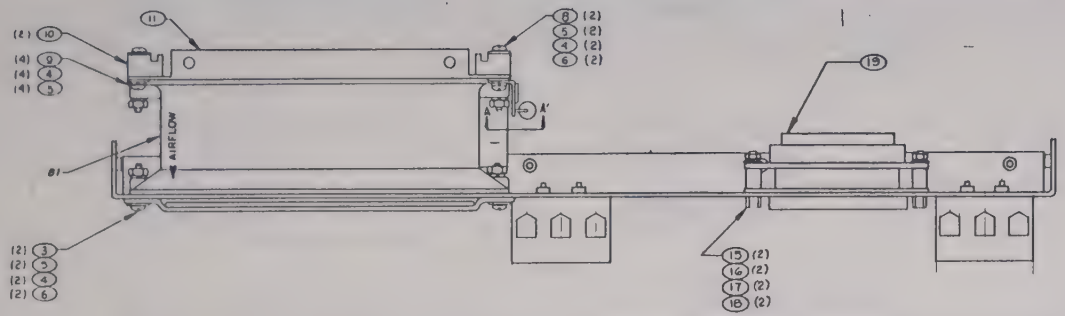
SCALE 1/2 — SHEET 1 OF 1

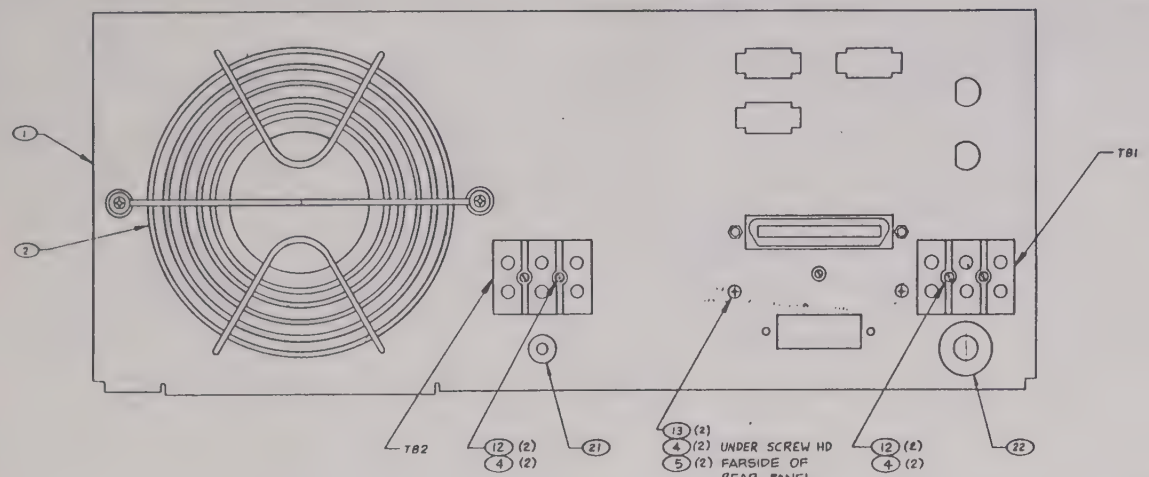
QTY REQD	USED ON	NEXT ASSY
1	9715XP	4000-410
1	1501XP	4000-408
-2 -1		

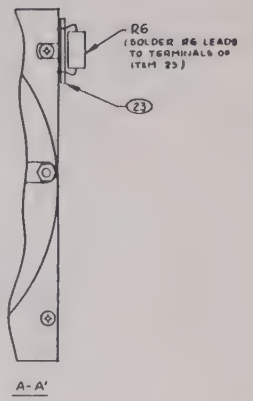
NOTES (UNLESS OTHERWISE SPECIFIED)

4000-404 B

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	REV B1 ON PL & TOP VIEW AIR	8/27/84	J Reed
B	VIEW OF ITEM 19 REDRAWN, ADD J SCREWS @ 19. R6, @ 23 ADDED WITH SECTION A-A'.	7/11/85	J Reed







FOR PARTS LIST SEE 4000-406-1

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30

BREAK ALL SHARP CORNERS & EDGES

MACH. SURFACES √

DWG SIZE D

TITLE: REAR PANEL ASSY

California Instruments

A DIVISION OF AMETEK TECHNICAL & INDUSTRIAL PRODUCTS INC SAN DIEGO CALIFORNIA

CONTRACT NO 16067

DWG NO 4000-406 REV B

SCALE 1:1 SHEET 1 OF 1

	NAME	DATE
RELEASE	A Reed	11/15
PROJ ENG	J REDUS	10-25-85
CHECK	AURNEETO	10/25/85
DESIGN		
DRAFT	R.I.C.E	10 25 84

ADDITIONAL APPROVALS: ENGINR 10/25

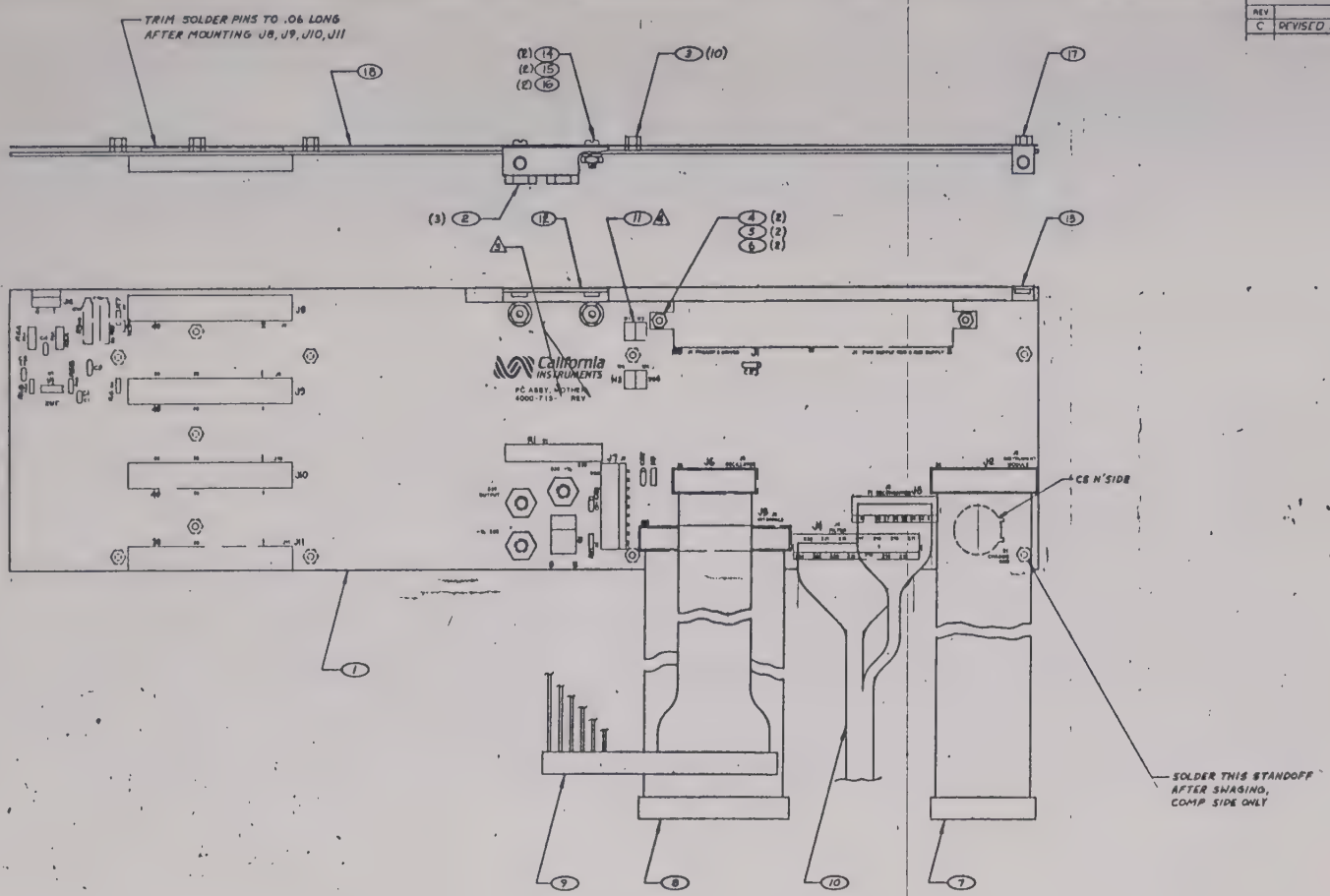
EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

QTY REQD	USED ON	NEXT ASSY
1	1301XP	4000-409
-1		

NOTES (UNLESS OTHERWISE SPECIFIED)

4000-406 B


TRIM SOLDER PINS TO .06 LONG AFTER MOUNTING J8, J9, J10, J11
CB N'SIDE
SOLDER THIS STANDOFF AFTER SWAGING, COMP SIDE ONLY
California Instruments
PC ASSY, MOTHER 4000-713- REV

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REVISED AND REDRAWN, SEE CBS DWG FRT	8-11-69	

⚠ BREAK THIS ITEM INTO 4 8-PIN PIECES BEFORE MOUNTING
⚠ MARK WITH REVISION LTR OF THIS DRAWING & APPROPRIATE PART NO.
2. FOR SCHEMATIC, SEE 4000-088
⚠ FOR PARTS LIST, SEE PL 4000-713-1, -2, -3, -4

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
1	971KP	4000-410
1	1301KP	4000-409

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY	-1, -2, -3, -4		⚠		

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES
DWG SIZE D
EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.
FINISH

TITLE: PC ASSY, MOTHER A1

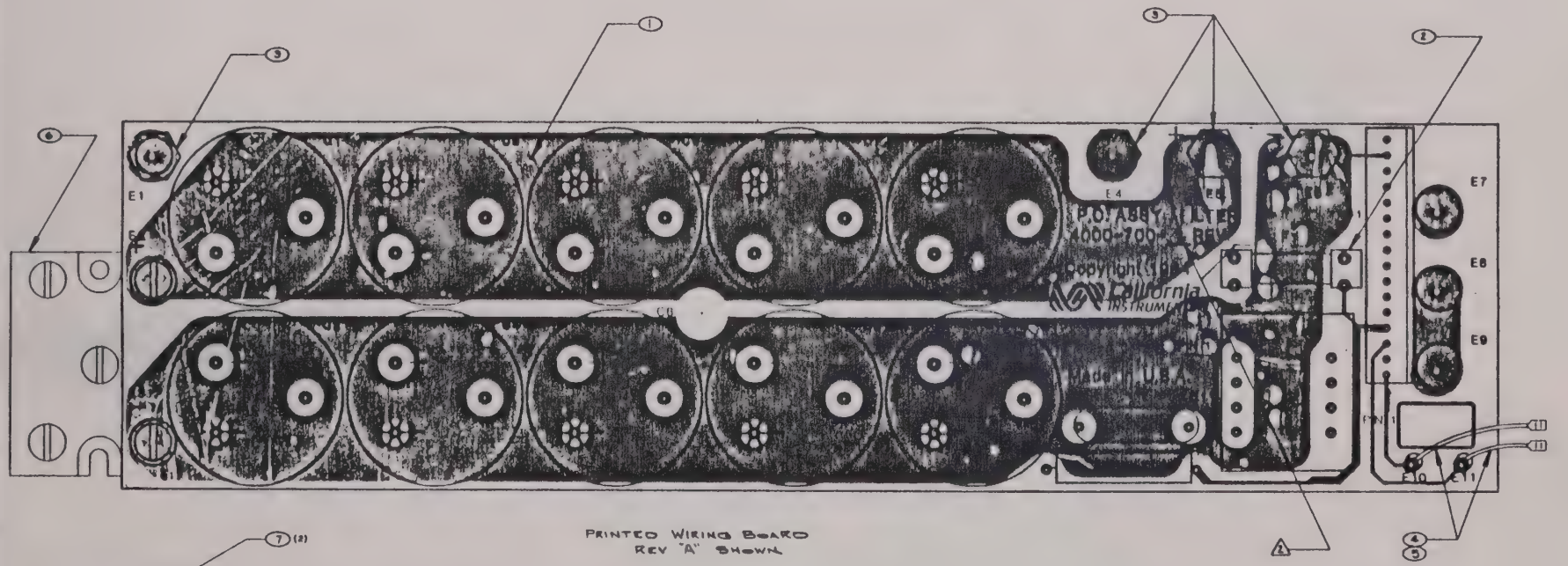
RELEASED	R Richard	9/15/69	ADDITIONAL APPROVALS
PROJ ENG	J Case	9-11-69	
CHECK	E Ewing	11-18	
DESIGN			
DRAFT	J. SPROAT	9-8-69	

California Instruments
A DIVISION OF AMBAC/TECHNI-ALPIN DIVISION INC SAN DIEGO CALIFORNIA

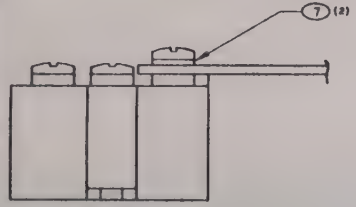
CONTRACT NO | CODE IDENT 16067
DWG NO 4000-713 | REV C
SCALE 1/1 | SHEET 1 OF 1

4000-713 C

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ENLARGE CTR MOUNTING HOLE TO .330	1/6/65	



PRINTED WIRING BOARD
REV "A" SHOWN



FOR PARTS LIST SEE 4000-700-1,2,3,4

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

QTY REQD -4	-3	-2	-1	USED ON	NEXT ASSY
			1	1901XP	4000-409
		1		971XP	4000-410
	1			651XP	4000-411
1				381XP	4000-412

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30' | BREAK ALL SHARP CORNERS & EDGES | MACH. SURFACES | DWG SIZE D

FINISH —

TITLE: PRINTED CIRCUIT ASSY FILTER A2

PROJ ENG	J Rovak	3-2-65	
CHECK	E.R.WINE	2-9-65	
DESIGN			
DRAFT	R.GERVAIS	11-5-64	4/6/65

ADDITIONAL APPROVALS

California Instruments — A DIVISION OF MISTER TECHNICAL INSTRUMENTS CO. INC. SAN DIEGO CALIFORNIA

CONTRACT NO — TYPE ORDER 14-067

DWG NO 4000-700 — REV A

SCALE 2/1 — SHEET 1 OF 1

4000-700

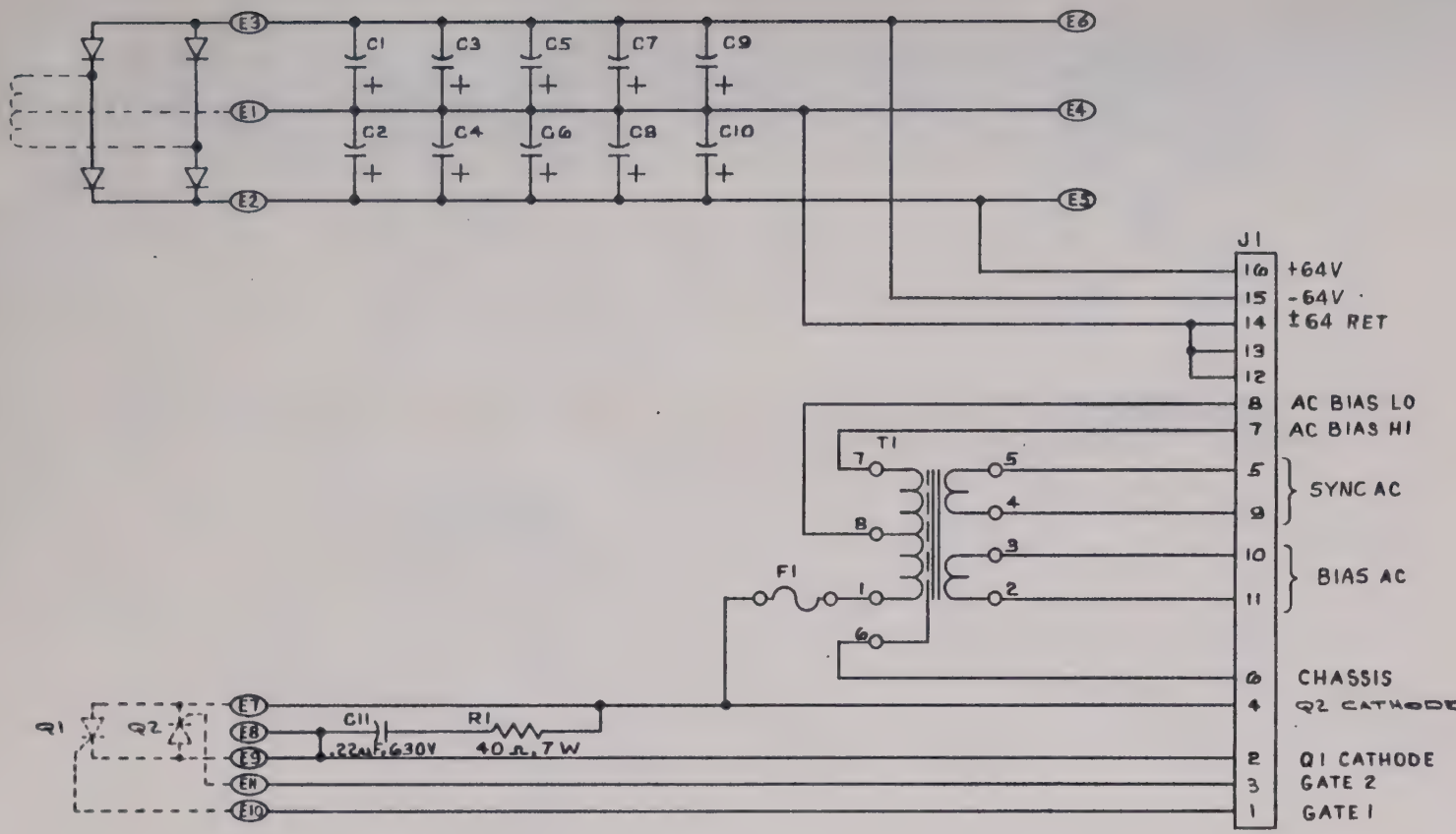
⚠ MARK WITH APPROPRIATE DASH NUMBER & REV LTR

1. FOR SCHEMATIC SEE 4000-081

NOTES (UNLESS OTHERWISE SPECIFIED)

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS CORPORATION AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

REV	DESCRIPTION	APPROVED	DATE
A	EXCH SYNC & BIAS 64V WAS 60V	AJR/JOM	3/85



1. C1 THRU C10 ARE 9500 μF, 75V

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
	1301XP	4000-700-4
	971XP	4000-700-3
	651XP	4000-700-2
REF	321XP	4000-700-1

REQD PER ASSY | ITEM NO | PART OR IDENTIFYING NO. | DESCRIPTION | MATERIAL - SPECIFICATION | CODE IDENT | NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30' | BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √ | DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

TITLE: SCHEMATIC, FILTER A2

			ADDITIONAL APPROVALS
RELEASE	R. Bedford	3/15/85	
PROJ ENG	J. ROUSE	3-22-85	
CHECK	ERWINE	3/19/85	
DESIGN			
DRAFT	BEACH	8-84	Rweals 3/85

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

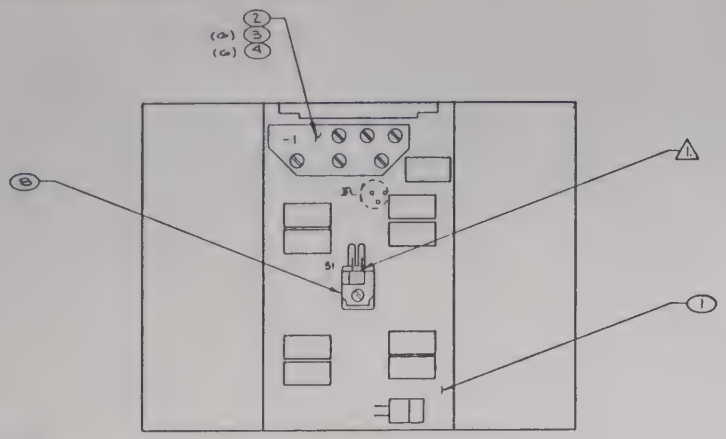
CONTRACT NO | CODE IDENT 16067

DWG NO 4000-081 | REV A

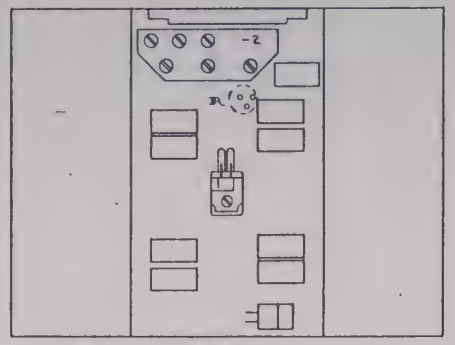
SCALE NONE | SHEET 1 OF 1

4000-081 A

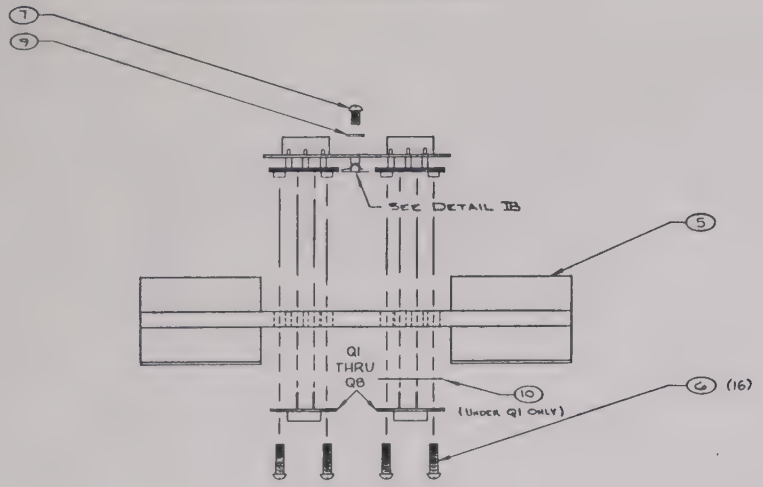
REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADDED INSULATOR & HEAT COMPOUND	7/14/04	
B	REVISED W1 FROM 20GA TO 16GA	7/29/04	



POSITIVE OUTPUT
-1 ASSEMBLY



NEGATIVE OUTPUT
-2 & -3 ASSEMBLIES
(SAME AS -1 EXCEPT AS SHOWN)



DETAIL A
SCALE 2/1

DETAIL B
SCALE 2/1

FOR PARTS LIST SEE 4000-401-1; -2; -3

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
			LIST OF MATERIAL			
1	2	1301XP	4000-409			
1	1	971XP	4000-410			
1	1	651XP	4000-411			
-3	-2	-1	USED ON	NEXT ASSY		
QTY REQD						

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X ± .1

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √

DWG SIZE D

FINISH —

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS CORPORATION AND SHALL NOT BE REPRODUCED OR USED IN ANY MANNER WHATSOEVER WITHOUT THE EXPRESS WRITTEN PERMISSION OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: HEATSINK ASSEMBLY, POWER AMPLIFIER

RELEASE	J Packard	4/1/05	ADDITIONAL APPROVALS
PROJ ENG	J RUPE	3/28/05	
CHECK	A J ROBERTO	4/18/05	ERWINE 3/29/05
DESIGN			
DRAFT	STANIARSKI	11/17/04	3/11

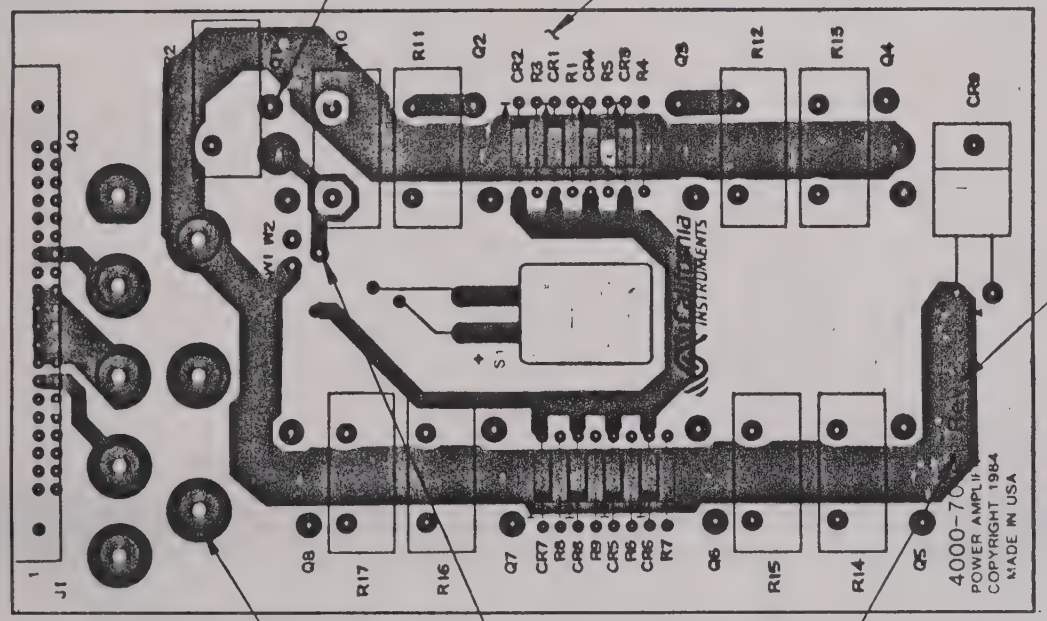
California Instruments
A DIVISION OF AMBAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

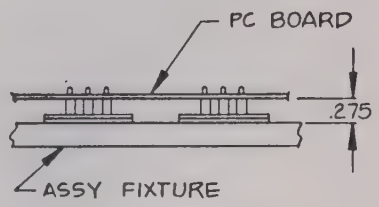
CONTRACT NO 16067
CODE IDENT
DWG NO 4000-401
REV B
SCALE 1/1
SHEET 1 OF 1

⚠ BREAK OFF MIDDLE LEAD BEFORE SOLDERING TO PADS.

NOTES (UNLESS OTHERWISE SPECIFIED)

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED





DETAIL A
SCALE: 1/1

FOR PARTS LIST SEE 4000-709-1

4. USE ASSY FIXTURE SK253 FOR INSTALLATION OF SOCKETS.
3. MARK WITH APPROPRIATE REV LTR.
2. MARK WITH APPROPRIATE DASH NO.
1. FOR SCHEMATIC SEE 4000-083

NOTES: (UNLESS OTHERWISE SPECIFIED)

REQD PER ASSY	ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT.	NOTE NO.
1		1301XP				4000-401
1		971XP				4000-401
1		651XP				4000-401
-1		USED ON				NEXT ASSY

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 XX ± .03 X° ± 30'
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES √
DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY, AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

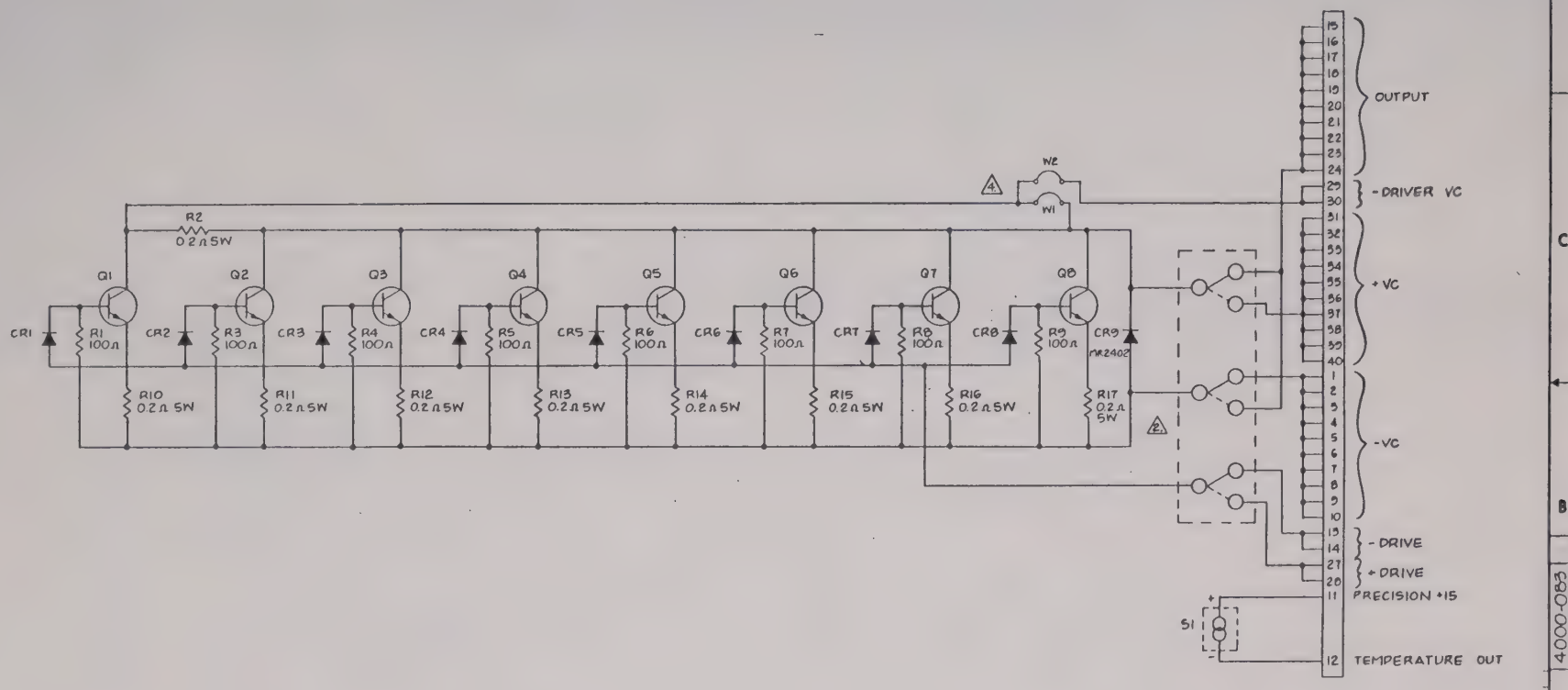
TITLE
PRINTED CIRCUIT ASSY-
POWER AMPLIFIER

			ADDITIONAL APPROVALS
RELEASE		5/25/85	
PROJ ENG	J. ROUSE	3-22-85	
CHECK	ERWINE	1-14-85	
DESIGN			
DRAFT	STAWARSKI	1/11/85	

California Instruments
A DIVISION OF AMBTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO, CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO 4000-709
REV
SCALE 2/1
SHEET 1 OF 1

4000-709



4 W1 USED ON 4000-401-1 & -2, W2 USED ON 4000-401-3 ONLY.
3 ALL TRANSISTORS ARE MJ15022.
2 SOLID LINE CONNECTIONS DENOTE NEGATIVE OUTPUT (4000-401-2 & -3).
DASHED LINE CONNECTIONS DENOTE POSITIVE OUTPUT (4000-401-1).
1. ALL DIODES ARE IN4004.

NOTES (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
	1301XP	4000-709
	971XP	4000-705
-REF-	651XP	4000-702

FINISH

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY		LIST OF MATERIAL			

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES √
DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

TITLE: SCHEMATIC DIAGRAM, POWER AMP

California Instruments
A DIVISION OF AMETEK TECHNICAL PRODUCTS CO. INC
SAN DIEGO CALIFORNIA

RELEASE	R. Edgard	3/15/72	ADDITIONAL APPROVALS
PROJ ENG	J. KRAUSE	5 2283	
CHECK	E. EWING	5/1/72	
DESIGN			
DRAFT	S. SAMARSKI	3/6/72	

CONTRACT NO | CODE IDENT 16067
DWG NO 4000-083 | REV
SCALE NONE | SHEET 1 OF 1

4000-083

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
D	REVISED & REDRAWN	8/27/85	J. Rouse 8-28-85
E	ADDED R127 TO CIRCUIT SIDE	9/3/85	J Rouse 9-3-85
F	SHEET 2 ADDED	9/12/85	J Rouse 9-12-85

(3) (4) (7) (16)

(2) (9) (10) (2)

(2) (5)

(2) (6)

(11) (4)

(8)

(17) (18) (2)

(16) (2)

(12)

(13) (14) (15) (2)

(1)

PREAMP/PWR SUPPLY

4000-710

Rev

Made in U.S.A.

Copyright 1985

SOLDER R127 OFF TO THE SIDE OF TP2 TO PREVENT INTERFERENCE WITH TEST FIXTURE

CIRCUIT SIDE

REMOVE SOLDER MASK AND SOLDER R127 TO TRACE AS SHOWN (JUNCTION OF C2 & C5) SLEEVE LEADS AS REQD

PRINTED WIRING BOARD
REV "D" SHOWN

FOR PARTS LIST SEE 4000-710-1 THRU -17

ITEM NO.	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT.	NOTE NO.	REQD PER ASSY

LIST OF MATERIAL

1. FOR SCHEMATIC, SEE 4000-080.

NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
1	1301XP	4000-409
1	971XP	4000-410
1	651XP	4000-411
1	321XP	4000-412
-1		

DIM IN INCHES
TOLERANCES
XXX ± .010
.XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE
PRINTED CIRCUIT ASSY, PREAMP / POWER SUPPLY

			ADDITIONAL APPROVALS
RELEASE	R. Fedyard	8/28/85	
PROJ ENG	J. Rouse	8/27/85	
CHECK	ERWINE	8/27/85	
DESIGN			
DRAFT	D.M. ERWINE	8/27/85	

California INSTRUMENTS
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO., INC
SAN DIEGO, CALIFORNIA

CONTRACT NO
CODE IDENT 16067

DWG NO 4000-710
REV F

SCALE 1/1
SHEET 1 OF 2

4000-710 F

B

A

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	CIRCUIT CHANGE, SH 2	4/84	
B	ADD VALUE CHART & NOTE 4, CIRCUIT CHNG SH 2	6/85	
C	REVISED VALUES	9/85	
D	ADDED R127 TO SH 2	9/85	
E	SEE SHEET 2	9/85	

PWR & GND CHART					
REF DES	+15V	-15V	GND	DECLP CAP +15V	DECLP CAP -15V
U1	8	4	A2	C44	C55
U3	7	4			
U4	11,14	4			
U5	8	4	A2	C47	C59
U6	8	4	A2		C58
U7	8	4	A2	C46	C57
U8	14		(7)A2		
U9	8	4	A2	C45	C56
U10	8	4			
U11	8	4	A2	C49	C61
U12	8	4	A2	C50	C62
U13	8	4	A2	C51	C63 C64
U17	8	4	A2	C48	C60
U24	7		4		
U25			A5	C66	

4. VALUES VARY PER ASSY, SEE PARTS LIST.
3. DIODES ARE IN4148.
2. CAPACITOR VALUES ARE IN MICROFARADS / VOLTS.
1. RESISTORS ARE ¼ WATT, 5%. VALUE IS IN OHMS.

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY		LIST OF MATERIAL			

QTY REQD	USED ON	NEXT ASSY
XP	4000-710	

DIM IN INCHES TOLERANCES XXX ± .010, XX ± .03, X° ± 30' — BREAK ALL SHARP CORNERS & EDGES MACH SURFACES — DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH ———

TITLE: SCHEMATIC, PHASE CONTROL POWER SUPPLY 4.3

			ADDITIONAL APPROVALS
RELEASE		9/25/85	
PROJ ENG	J. ROUSE	3-22-85	
CHECK	ERWINE	9/25/85	
DESIGN			
DRAFT	BEACH	7-84	

California Instruments — A DIVISION OF AMETAR TECHNICAL PRODUCTS CO INC SAN DIEGO CALIFORNIA

CONTRACT NO 16067 — CODE IDENT

DWG NO 4000-080 — REV E

SCALE NONE — SHEET 2

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	CIRCUIT CHANGE	4/9/85	
B	ADD VALUE CHART (SH 1), NOTE 4, CIRCUIT CHANGE SH 2	4/15/85	
C	ADDED POT; REVISED VALUES	5/1/85	
D	ADDED R127 RESISTOR	5/6/85	
E	VALUE CHNG R3, REMOVE R6,7,8, C15, ADD CB1 R128	5/24/85	

J1 (PART OF)

- 73 NEG FDBK
- 75 OSCILLATOR INPUT (N
- 86 +65 VDC
- 98 } +68 VDC
- 97 }
- 96 (+) DRIVE
- 82 +18VO
- 81 -18VO
- 80 +15VO
- 79 -15VO
- 95 T2-1
- 83 } ±65 COMM.
- 84 }
- 93 (-) DRIVER VC
- 94 (-) DRIVE
- 99 } -68 V DC
- 100 }
- 88 } +68 V DC
- 87 }
- 85 OVERLOAD
- 76 (+) H.S. TEMP
- 78 } +15V(A)
- 77 }
- 89 REMOTE SHUTDOWN
- 72 I SENSE LO
- 71 I SENSE HI
- 70 CL PROGRAM
- 69 RECT. I SENSE
- 67 (-) H.S. TEMP
- 66 OVER TEMP

NOTES: (UNLESS OTHERWISE SPECIFIED)

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

REQD PER ASSY

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 XX ± .03 X° ± 30 — BREAK ALL SHARP CORNERS & EDGES — MACH SURFACES ✓ — DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

QTY REQD | XP | USED ON | 4000-710 | NEXT ASSY

TITLE

SCHEMATIC

PHASE CONTROL POWER SUPPLY

A3

			ADDITIONAL APPROVALS
RELEASE	R Gervais	3/25/85	
PROJ ENG	J ROUSE	3-27-85	
CHECK	E EWINE	3/29/85	
DESIGN			
DRAFT	R. GERVAIS	7-12-84	Engle 4/85

California Instruments
A DIVISION OF AMETAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO | CODE IDENT 16067

DWG NO 4000-080 | REV E

SCALE NONE | SHEET 2 OF 2

C	ADDED R27; REVISED VALUES	8/31/85 J Rouse 8/28/85
D	ADDED R127 RESISTOR	9/85 J Rouse 9-3-85
E	VALUE CHNG R3, REMOVE R6,7,8, C15, ADD C81 R128	9/26/85 J Rouse 9-26-85

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	CIRCUIT CHANGE	4/9/85	
B	ADD VALUE CHART (SH1), NOTE A, CIRCUIT CHANGE SH2	6/3/85	J Rouse 6/3/85

J1 (PART OF)

T3 NEG FDBK
T79 OSCILLATOR INPUT (HI)
T86 +65 VDC
T98, T97 +68 VDC
T96 (+) DRIVE
T82 +18VO
T81 -18VO
T80 +15VO
T70 -15VO
T90 T2-1
T83, T84, T69, T77 ±65 COMM.
T92 (-) DRIVER VC
T94 (-) DRIVE
T93, T88 -65 V DC
T86, T87 -68 V DC
T85 OVERLOAD
T66 (+) H.S. TEMP
T74, T75 +15V(A)
T89 REMOTE SHUTDOWN
T72 I SENSE LO
T71 I SENSE HI
T68 CL PROGRAM
T91 RECT. I SENSE
T67 (-) H.S. TEMP
T65 OVER TEMP

CR11 IN4004
TP3
Z8 10K 1%
Z1 1K, 1%
C17 0.1M
A3
Q2 MPSA92
Q3 MDS21
C11 0.001mf 1KV
Q13 MJ15022
Q14 MJ15022
R13 100Ω
R14 7.5Ω
CA3280AG
U4
Q1 MPSA42
R7B 27K
CR34 CR27 CR28 CR53 VR14
R21
C8
R22 100K 1%
Z6 470Ω
R23 33Ω 1W
TP4
C7 100pf
R19
Z11 10K 1%
A2
R20 27K
CR29 CR30 CR31 CR8 CR54 VR15
Q4 MPSA92
Z2 100K
CR25
Q9 PN2907A
R24 10Ω 1W
Q16 MJ15023
R15 MJ15022
R35 7.5Ω
R36 33Ω 1W
Q5 MPSA42
Q6 MDS60
C7B 150pf (TBD)
R34 100Ω
C12 0.001mf 1KV
CR12 IN4004
C10 0.1M
R33 10M
CR20
C9 0.1M
U10 LF353N
Z5 2.2K
TP10
TP9
TP5
C18 1.0mf
W1
Q11 PN2222A
CR35
U2
H11F2
DS1
R47 470Ω 1/4W 5%
CR10
R115 2.2K
R45 36.5K 1%
R46 10K 1%
CR22 10V IN5240B
CR23 4.7V IN5230B
Q12 PN2907A
-15V
CR26
Z9 100K 1%
Z10 1K
+18V
+15V(A)
RG1 604K 1%
RG2 60.4K 1%
VR6 TL431C
VR7 TL431C
R72 12.1K 1%
R73 12.1K 1%
-15V(A)
-18V

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
REQD PER ASSY					

LIST OF MATERIAL

DIM IN INCHES TOLERANCES .XXX ± .010 XX ± .03 X° ± 30'
BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓
DWG SIZE D

TITLE
SCHEMATIC
PHASE CONTROL POWER SUPPLY
A3

California Instruments
A DIVISION OF AMETAR TECHNICAL PRODUCTS CO INC SAN DIEGO CALIFORNIA

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

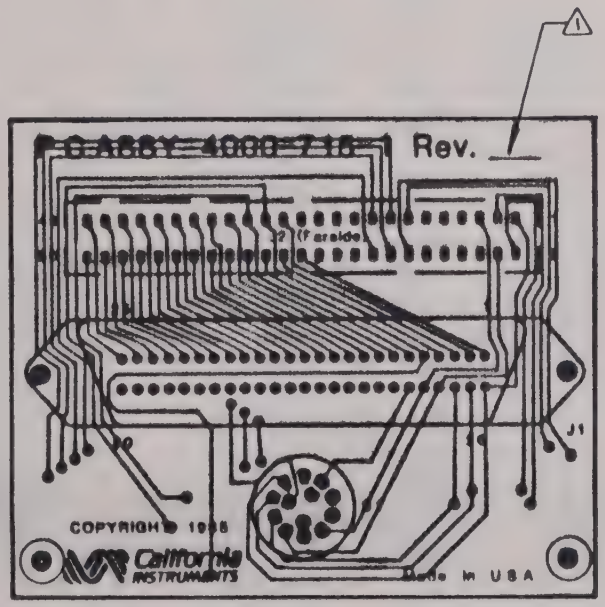
FINISH

RELEASE			ADDITIONAL APPROVALS
PROJ ENG	J. ROUSE	3-27-85	
CHECK	E. ERWINE	3/19/85	
DESIGN			
DRAFT	R. GERVAIS	7-12-84	3/85

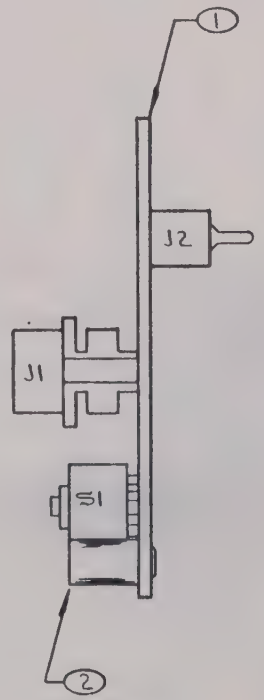
CONTRACT NO 16067
DWG NO 4000-080 REV E
SCALE NONE SHEET 2 OF 2

QTY REQD	USED ON	NEXT ASSY
XP	4000-710	

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
C	REVISED & REDRAWN	8/6/85	8-5-85



PRINTED WIRING BOARD
REV "D" SHOWN



(2 REQD)

FOR PARTS LIST SEE PL 4000-715-1

ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

REQD PER ASSY	USED ON	NEXT ASSY
1	1301XP	4000-406-1
1	971XP	4000-429-1
1	651XP	4000-407-1
1	321XP	4000-407-1
-1		

2. FOR SCHEMATIC SEE 4000-080

⚠ PERMANENTLY MARK ASSY REV. LTR WHERE SHOWN.

NOTES: (UNLESS OTHERWISE SPECIFIED)

DIM IN INCHES
TOLERANCES
XXX ± 010
XX ± 03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH

TITLE
PRINTED CIRCUIT ASSY,
PHASE SELECTOR SWITCH

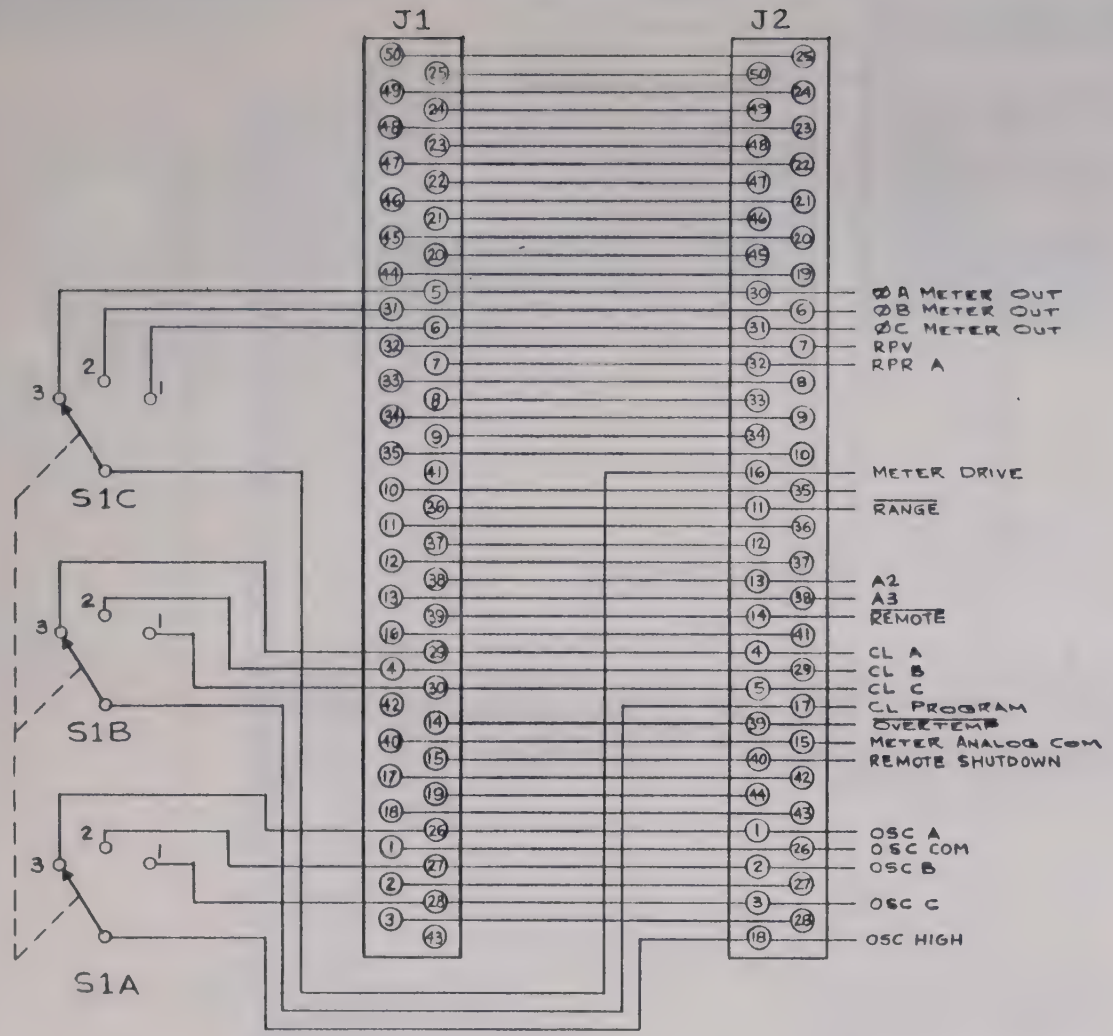
			ADDITIONAL APPROVALS
RELEASE	R. Ledyard	8/6/85	
PROJ ENG	J. Rouse	8/5/85	
CHECK	ERWINE	8/5/85	
DESIGN			

California INSTRUMENTS
A DIVISION OF AMBTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO 4000-715
REV C
SCALE
SHEET 1 OF 1

4000-715

A	REVERSE PINS 1 & 3 ON S1 SECTIONS A, B & C J1 CORRECTED.	2/8/85	BK



NOTES: (UNLESS OTHERWISE SPECIFIED)

QTY REQD	USED ON	NEXT ASSY
	1301XP	4000-715-1
	971XP	4000-715-1
	651XP	4000-715-1
	321XP	4000-715-1

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

DIM IN INCHES TOLERANCES XXX ± .010 XX ± .03 X° ± 30' | BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓ | DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH ———

TITLE
SCHEMATIC, PHASE SELECTOR SWITCH

California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

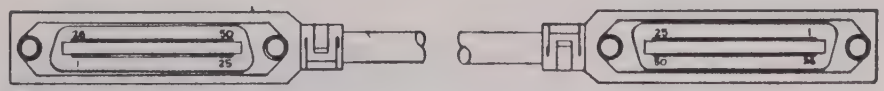
			ADDITIONAL APPROVALS		
RELEASE	A. Sedgard	3/25/85			
PROJ ENG	J. ROUSE	3-22-85			
CHECK	AJ ROBERTO	2/FEB 85	ERWINE	Valas	
DESIGN					
DRAFT	C DELPINO	11/26/84	Kimple	3/85	

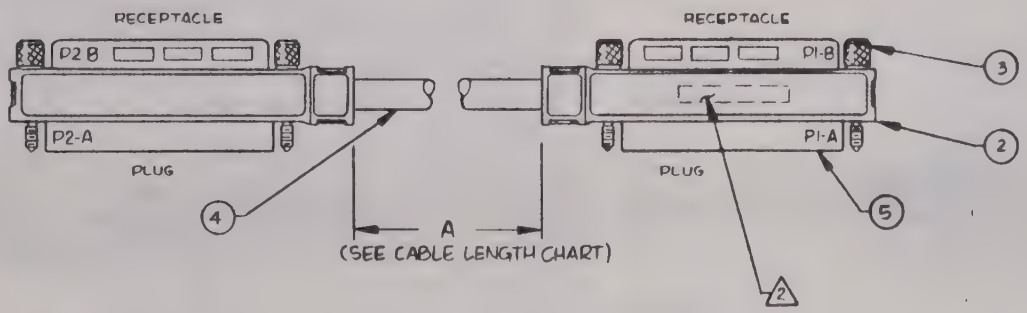
CONTRACT NO | CODE IDENT 16067
DWG NO 4000-086 | REV A
SCALE NONE | SHEET 1 OF 1

4000-086 A

4 3 2 1

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED
A	ADD TOP VIEW, SHEET 2, CHANGE PL.	9/85	





CABLE LENGTH	
ASSY	A DIM
-1	80"

REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO
2	5	552772-1	PLUG/RECEPTACLE	AMP	00779	
1	4	9546	24GA STRANDED COND	BELDEN	70903	
4	3	4000-279-1	JACK SCREWS		16067	
2	2	552773-1	STRAIN RELIEF CVR	AMP	00779	
1		-1	CABLE ASSY			
-1						

LIST OF MATERIAL

QTY REQD	USED ON	NEXT ASSY
	XP SERIES	

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES ✓

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH —

TITLE
CABLE ASSY
SYSTEM INTERFACE

			ADDITIONAL APPROVALS
RELEASE	B Bedgood	5/2/85	
PROJ ENG	J ROUSE	5/1/85	
CHECK	ERWINE	5/1/85	
DESIGN			
DRAFT			

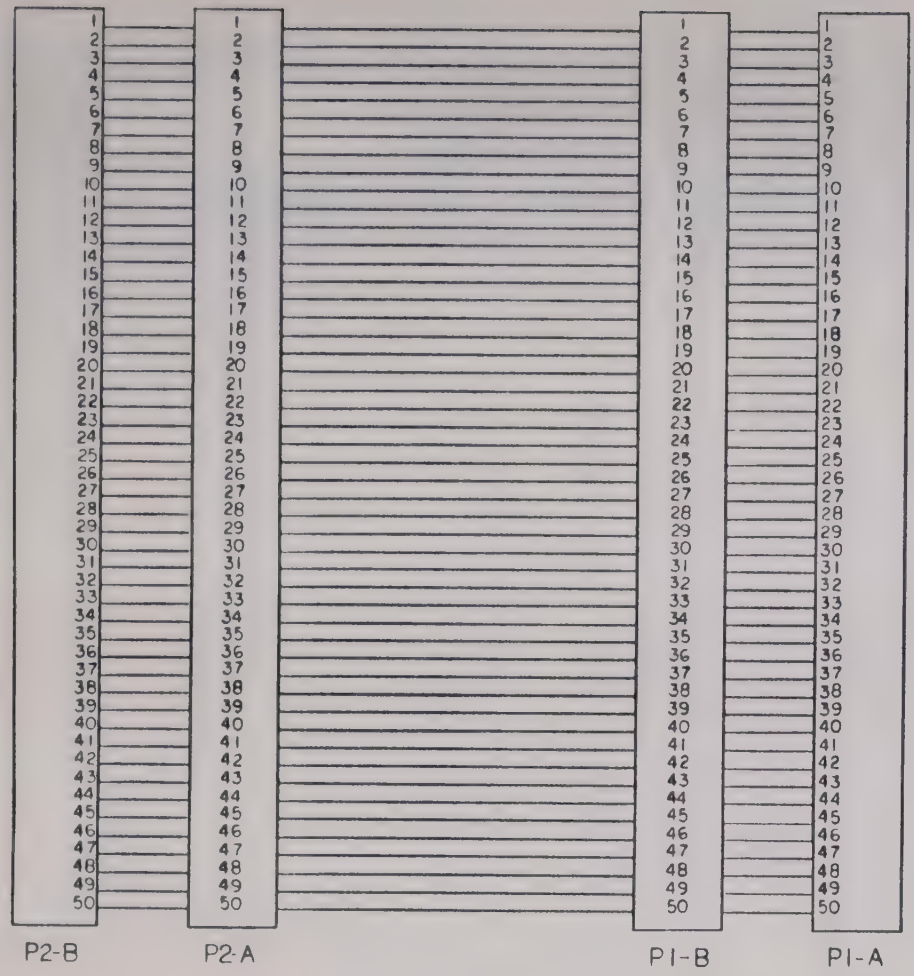
California Instruments
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO 4000-427
REV A

⚠2 MARK WITH PART NO.
1. FOR SCHEMATIC SEE SHEET 2.
NOTES: (UNLESS OTHERWISE SPECIFIED)

4000-427 A

REV	DESCRIPTION	DATE	APPROVED
A	SHEET 2 ADDED	5/85	



REQD PER ASSY	ITEM NO	PART OR IDENTIFYING NO.	DESCRIPTION	MATERIAL - SPECIFICATION	CODE IDENT	NOTE NO

LIST OF MATERIAL

QTY REQD	USED ON	NEXT ASSY
	XP SERIES	

NOTES: (UNLESS OTHERWISE SPECIFIED)

DIM IN INCHES
TOLERANCES
XXX ± .010
XX ± .03
X° ± 30'

BREAK ALL SHARP CORNERS & EDGES
MACH SURFACES
— √

DWG SIZE C

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALIFORNIA INSTRUMENTS COMPANY AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION

FINISH ———

TITLE
SCHEMATIC, SYSTEM INTERFACE

			ADDITIONAL APPROVALS
RELEASE	A. Edgard	5/29/85	
PROJ ENG	J. Rouse	5/29/85	
CHECK	ERWINE	5/29/85	
DESIGN			
DRAFT	RICE	5/21/85	

California INSTRUMENTS
A DIVISION OF AMSTAR TECHNICAL PRODUCTS CO INC
SAN DIEGO CALIFORNIA

CONTRACT NO
CODE IDENT 16067
DWG NO 4000-427
REV A
SCALE NONE
SHEET 1 OF 1

4000-427 A

4 3 2 1

SECTION VII

REPLACEABLE PARTS

7.1 GENERAL

This section contains ordering information and a complete list of replaceable parts. The parts are listed by their major assembly in alpha-numeric order by their reference designators. The list includes the parts description, manufacturers' identification (see Appendix A for list of manufacturers), and California Instruments` part numbers.

7.2 ORDERING INFORMATION

In order to ensure prompt, accurate service, please provide the following information, when applicable, for each replacement part ordered.

a. Model number and serial number of the instrument.

b. California Instruments part number for the sub-assembly where component is located (PARENT ITEM NO.).

c. Component reference designator (SEQ NO.).

d. Component description (DESCRIPTION TRUNCATED).

e. Component manufacturer's FSCM number (VENDOR).

f. California Instruments part number (COMPONENT ITEM NO.).

A further explanation of these terms can be found in Section 7.3.

All replacement part orders should be addressed to:

California Instruments
Attention: Parts Department
5150 Convoy Street
San Diego, California 92111-1266

7.3 COMPUTER GENERATED PARTS LISTS

The following information is included as an explanation of the computer formatted parts list column.

7.3.1 "SEQ NO." - Sequence Number: the reference designator or the component, or (if there is no reference designator) the balloon number (bubble or "find" number) on the face of the assembly drawing or the top assembly drawing. They are listed in alpha-numeric order.

7.3.2 "COMPONENT ITEM NO." - This is California Instruments' part number. Please use this number when ordering spares or replacements.

7.3.3 "DESCRIPTION TRUNCATED" - A brief description of the item. The abbreviations are per MIL-STD-12 or industry accepted standards.

7.3.4 "ENGINEERING DRAWING NUMBER" - This is used for one of the following:

a. The document/specification number generated by California Instruments to control the part.

b. The generic part number (military specifications or industry accepted standard).

c. The premary vendor's catalog part number. an asterisk at the end of the number indicates number is longer than that shown. (Contact California Instruments if the full number is required.)

7.3.5 "VENDOR" - This is the FSCM code to identify the manufacturer. (See Appendix A).

7.3.6 "QTY" - This is the Quantity and Unit of Measure used in the assembly. The Unit of Measure abbreviations are per MIL-STD-12 or industry accepted standard.

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
	4000-050-0	HARNESS ASSY,JUMPER	4000-050 REV D	16067	1.0	EA
	4000-050-2	HARNESS ASSY	4000-050 REV D	16067	1.0	EA
	4000-050-3	HARNESS ASSY	4000-050 REV D	16067	1.0	EA
	4000-050-4	HARNESS ASSY	4000-050 REV D	16067	1.0	EA
	4000-050-5	HARNESS ASSY	4000-050 REV D	16067	1.0	EA
	4000-050-6	HARNESS ASSY	4000-050 REV D	16067	1.0	EA
	4000-050-7	HARNESS ASSY	4000-050 REV D	16067	1.0	EA
A1	4000-713-1	PC ASSY,MOTHER BD,1000VA	4000-713 REV C	16067	1.0	EA
A2	4000-700-4	PC ASSY,FILTER	4000-700 REV A	16067	1.0	EA
A3	4000-710-14	PC ASSY,1301XP, 5KHZ	4000-710 REV G	16067	1.0	EA
A4	4000-401-1	HEATSINK ASSY,PWR AMP	4000-401 REV B	16067	2.0	EA
A5	4000-401-2	HEATSINK ASSY,PWR AMP	4000-401 REV B	16067	1.0	EA
A6	4000-401-3	HEATSINK ASSY,PWR AMP	4000-401 REV B	16067	1.0	EA
C1	610577	CAP,MYLAR,.47UF,100V	1DP-4-474	72136	1.0	EA
C2	FS7002	CAP,TBD	TBD	81349	1.0	EA
C3	FS7002	CAP,TBD	TBD	81349	1.0	EA
C4	611137	CAP,PP,10UF,135VAC	93581C106	14752	1.0	EA
K1	245182	RELAY,POWER,2C,30A,24VDC	21CPX-3 24VDC	94696	1.0	EA
L1	4000-011-1	INDUCTOR,.5MH,15A,E100	4000-011-1	16067	1.0	EA
R1	550189	RES,PWR,50W,.01 OHM,1%	RH-50-73-.01	91637	1.0	EA
R2	550207	RES,PWR,7W,2.5 OHM,5%	RS-7-2.5 OHM	91637	1.0	EA
R3	FS7000	RES,CARB,1/4W,TBD	RC07GF...	81349	1.0	EA
R4	550266	RES,PWR,30W,150 OHM	F313	44655	1.0	EA
R5	550266	RES,PWR,30W,150 OHM	F313	44655	1.0	EA
R7	FS7000	RES,CARB,1/4W,TBD	RC07GF...	81349	1.0	EA
R8	FS7000	RES,CARB,1/4W,TBD	RC07GF...	81349	1.0	EA
R9	550211	RES,PWR,30W,250 OHM	F315	44655	1.0	EA
R10	550211	RES,PWR,30W,250 OHM	F315	44655	1.0	EA
R11	550211	RES,PWR,30W,250 OHM	F315	44655	1.0	EA
R12	540071	RES,CARB,1W,4.7M OHM	RC32GF475J	81349	1.0	EA
R13	540071	RES,CARB,1W,4.7M OHM	RC32GF475J	81349	1.0	EA
R14	540071	RES,CARB,1W,4.7M OHM	RC32GF475J	81349	1.0	EA
TB4	250086	TERMINAL STRP, 6TERM,1MT	901	83330	1.0	EA
T1	4000-019-1	TRANSFORMER,INPUT	4000-019 REV A	16067	1.0	EA
T2	4000-018-1	TRANSFORMER,OUTPUT	4000-018 REV A	16067	1.0	EA
T3	CIC604-4	CUR TRANS,BURDEN RES SEL	CIC604-4 REV 0	16067	1.0	EA
1	FS1029	SCREW,FLH,S/S,6-32X3/8	MS24693-C26	96906	11.0	EA
2	FS1028	SCREW,PNH,S/S,6-32X5/16	MS51957-27	81349	18.0	EA
3	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-23	96906	9.0	EA
4	FS1049	SCREW,PNH,S/S,8-32X7/16	MS51957-44	81349	4.0	EA
5	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	7.0	EA
6	FS1065	NUT,HEX,S/S,8-32	MS35649-284	96906	11.0	EA
7	FS1086	NUT,HEX,S/S,4-40X3/16	4-40X3/16	81349	2.0	EA
8	FS1067	NUT,HEX,S/S,10-32	MS35650-304	96906	4.0	EA
9	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	2.0	EA
10	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	33.0	EA
11	FS1074	WASHER,SPLT,S/S,#8	MS35333-137	96906	20.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
12	FS1075	WASHER,SPLT,S/S,#10	MS35338-138	96906	4.0	EA
13	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	18.0	EA
14	FS1081	WASHER,FLAT,S/S,#8	MS15795-841	96906	13.0	EA
15	210097	WASHER,FLAT,1/4	MS15795-810	96906	8.0	EA
16	210298	NUT,HEX,S/S,1/4-20	MS35649-2254	96906	8.0	EA
17	210459	WASHER,SPLT,1/4	MS35338-139	96906	15.0	EA
19	210787	STANDOFF,M/F,8-32X3-1/2"	AL6932-3.500-22	05791	1.0	EA
20	210815	SPACER, #8 X 718,ALUM	9234-A-171	06540	2.0	EA
22	330336	THYR,SCR,60A,800V,TO204	TT60N800KOC	24972	1.0	EA
27	4000-225-2	INSULATOR,HEATSINK,.250	4000-225-2	16067	2.0	EA
28	4000-231-1	SUPPORT,COVER,FRONT,6"FAN	4000-231-1	16067	1.0	EA
29	4000-232-1	COVER,SIDE,CONNECTOR 6"F	4000-232-1	16067	1.0	EA
30	4000-233-1	COVER,TOP,6"FAN	4000-233-1	16067	1.0	EA
31	4000-234-1	GUIDE,COVER,FRONT,6"FAN	4000-234-1	16067	2.0	EA
32	4000-404-1	FRONT PANEL ASSY	4000-404 REV 3	16067	1.0	EA
33	4000-255-1	BRACKET,COVER SUPPORT	4000-255-1	16067	1.0	EA
34	4000-256-1	COVER,SIDE,6"FAN	4000-256-1	16067	1.0	EA
38	4000-406-1	REAR PANEL ASSY	4000-406 REV 3	16067	1.0	EA
42	FS4001	THERMAL COMPOUND	351	13103	1.0	OZ
44	FS4016	ADHESIVE/SEALANT,LOCTITE	38050	05972	.0	OZ
47	4000-250-1	COVER,CHASSIS	4000-250-1	16067	1.0	EA
51	4000-263-1	BRACKET,MTG,TORUS	4000-263	16067	1.0	EA
52	210171	SCREW,PNH,S/S,6-32X1-1/4	MS51957-35	96906	1.0	EA
53	210309	BUMPER,RUBBER	2193	08065	1.0	EA
54	FS1043	SCREW,FLH,S/S,8-32X3/8	MS24693-C48	81349	1.0	EA
55	4000-241-1	CHASSIS	4000-241	16067	1.0	EA
56	210271	BOLT,HEX,S/S,1/4-20X1/2	MS35307-303	96906	7.0	EA
57	4000-236-2	BRACKET, REAR SUPPORT	4000-236	16067	10.0	EA
58	4000-426-1	HARNESS ASSY,JUMPER	4000-426	16067	4.0	EA
59	FS1099	WASHER,FLAT,FIBRE,#3X.44	2259-F171	06540	2.0	EA
60	FS1100	NUT,HEX,BRASS,8-32	41333116	33855	4.0	EA
61	FS1103	WASHER,FLAT,S/S,#5X.3100	MS15795-805	81349	3.0	EA
65	FS1070	WASHER,INTER,S/S,#8	MS35333-72	81349	12.0	EA
66	4000-252-1	COVER,TERM BD W/4000-252	4000-252	16067	1.0	EA
67	250419	TERM STRAP,COPPER	4805-16-3	86928	5.0	EA
68	FS1041	SCREW,PNH,S/S,8-32X5/16	MS59157-42	81349	12.0	EA
69	FS3001	GROMMET,STRIP,.085	CSG-09-BLACK	95987	12.0	IN
70	210841	BUMPER,RUBBER	F106	31827	4.0	EA
71	FS1062	SCREW,PNH,S/S,10-32X3/4	MS51958-65	96906	4.0	EA
73	210859	SCREW,PNH,S/S,8-32X2-1/2	MS51957-55	96906	2.0	EA
74	250359	LUG,RING,SOLDER,#6	809	79963	4.0	EA
75	FS6003	TUBING,SHRINK,1/4	CP221-1/4-BLK	24011	4.0	IN
76	FS4005	NOMEX,.010 THK,NATURAL	NOMEX,.010 THK	81349	336.0	SI
77	FS4004	ADHESIVE,SPRAY	77	04963	.5	OZ
78	FS6003	TUBING,SHRINK,1/4	CP221-1/4-BLK	24011	6.0	IN
79	4995-146-1	DECAL,SCREW PENETRATION	4995-146-1	16067	1.0	EA
80	4848-205-1	CABLE ASSY,GPIB(-PC)	4848-205-1	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	410293	TERMINAL,CRIMP	08-55-0105	27264	23.0	EA
2	410407	CONN,PC HSG,9 PIN	09-50-3091	27264	1.0	EA
3	410351	CONN,PC HSG,16 PIN	09-50-3161	27264	1.0	EA
4	FS2026	LUG,RING,CRIMP,3-8	R35038F	14726	2.0	EA
5	FS2001	LUG,RING,CRIMP,22/18-10	R4149SF	14726	4.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	FS2029	LUG,RING,CRIMP,12/10-6	R4189F	14726	2.0	EA
3	410293	TERMINAL,CRIMP	08-56-0105	27264	2.0	EA
5	FS2012	LUG,RING,CRIMP,12/10-10	R4170F	14726	4.0	EA
6	FS2027	LUG,RING,CRIMP,22/16-8	R4267SF	14726	1.0	EA
7	FS2032	LUG,S/O,F,CRMP,22/18-187	S09619SF	14726	2.0	EA
9	4000-248-1	BRKT,TERM BD,AC VOLT SEL	4000-248-1	16067	1.0	EA
10	4000-251-1	TERM BD,V SEL W/4000-251	4000-251	16067	1.0	EA
12	210790	STANDOFF,M/F,6-32X5/8	9797-SS-0632	06540	4.0	EA
13	210096	STANDOFF,6-32 X 3/8"	1551D-11	38245	4.0	EA
14	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	4.0	EA
15	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	4.0	EA
16	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	4.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	FS2028	LUG,RING,CRIMP,8-8	R35C38F	14726	3.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	FS2013	LUG,RING,CRIMP,8-1/4	R3032BF	14726	5.0	EA
2	FS2003	LUG,RING,CRIMP,8-10	R3031BF	14726	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	FS2013	LUG,RING,CRIMP,3-1/4	R3032BF	14726	1.0	EA
2	FS2003	LUG,RING,CRIMP,3-10	R3031BF	14726	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
XK1	245183	SOCKET,RELAY 8 CONTACT	S-2408-AB	94696	1.0	EA
1	FS2004	LUG,RING,CRIMP,12/10-6	R4183F	14726	2.0	EA
2	FS2029	LUG,RING,CRIMP,12/10-8	R4189F	14726	1.0	EA
3	FS2020	LUG,RING,CRIMP,22/18-1/4	5114	83330	1.0	EA
4	FS2001	LUG,RING,CRIMP,22/18-10	R4149SF	14726	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	FS2012	LUG,RING,CRIMP,12/10-10	R4170F	14726	2.0	EA
2	FS2024	LUG,RING,CRIMP,12/10-1/4	R4171F	14726	1.0	EA
3	FS2029	LUG,RING,CRIMP,12/10-8	R4189F	14726	3.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C31	270114	CIRCUIT BREAKER,35A,120V	APGX-66-1-65-35	81541	1.0	EA
DS1	250412	LAMP,NEON,AMBER,120V	1050QN3	91802	1.0	EA
1	4000-228-1	BRACKET,PLUG-IN,OSC	4000-228-1	16067	1.0	EA
2	4000-238-1	PANEL,FRONT W/4000-238	4000-238-1	16067	1.0	EA
3	4000-237-1	BRACKET,MOUNTING,PWB	4000-237-1	16067	1.0	EA
4	240225	HANDLE,FLT,S/S,4-9/16"	11519-S-0832-4	06540	2.0	EA
5	241124	GUIDE,PWB,4.15"	33-9016-12-01-*	91562	2.0	EA
8	FS1024	SCREW,PNH,S/S,6-32X3/16	MS51957-25	96906	4.0	EA
9	FS1029	SCREW,FLH,S/S,6-32X3/8	MS24693-C26	96906	2.0	EA
10	FS1046	SCREW,FLH,S/S,8-32X5/8	MS24693-C51	96906	4.0	EA
11	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	5.0	EA
12	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	4.0	EA
13	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	5.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R6	550241	RES,PWR,5W,25 OHM,5%	RS-5-25 OHM	91637	1.0	EA
TB1	240321	TERMINAL BLK, 3TERM,85A	9-85-3	75382	1.0	EA
TB2	240321	TERMINAL BLK, 3TERM,85A	9-85-3	75382	1.0	EA
B1	4000-274-1	FAN,6",48VDC (MODIFIED)	4000-274	16067	1.0	EA
1	4000-245-1	PANEL,REAR W/4000-245	4000-245-1	16067	1.0	EA
2	210074	FAN GUARD	5506	23936	1.0	EA
3	FS1037	SCREW,PNH,S/S,6-32X7/8	MS51957-33	96906	2.0	EA
4	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	14.0	EA
5	FS1080	WASHER,FLAT,S/S,#6	MS15795-806	96906	10.0	EA
6	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	4.0	EA
8	FS1038	SCREW,PNH,S/S,6-32X1	MS51957-34	96906	2.0	EA
9	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	4.0	EA
10	4000-254-1	GUIDE,COVER,REAR,6"FAN	4000-254-1	16067	2.0	EA
11	4000-253-1	SUPPORT,COVER,REAR,6"FAN	4000-253-1	16067	1.0	EA
12	210171	SCREW,PNH,S/S,6-32X1-1/4	MS51957-35	96906	4.0	EA
13	FS1032	SCREW,PNH,S/S,6-32X1/2	MS51957-30	96906	2.0	EA
15	4000-278-7	STANDOFF,M/F,4-40	4000-278-7	16067	2.0	EA
16	FS1079	WASHER,FLAT,S/S,#4	MS15795-804	96906	2.0	EA
17	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	2.0	EA
18	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
19	4000-715-1	PC ASSY,PHASE SELECTOR	4000-715 REV B	16067	1.0	EA
21	210173	GROMMET,RUBBER,7/16"DIA	3241	08065	1.0	EA
22	210089	GROMMET,RUBBER,7/8"DIA	2187	83330	1.0	EA
23	250052	TERMINAL STRP, 2TERM,1MT	863	83330	1.0	EA

EQ O.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR2	310210	DIODE,ZNR,27V,.5W,10%	1N5254A	04713	1.0	EA
CR3	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
C1	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C2	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C3	611091	CAP,CER,22PF,25V	CN15C220J	71590	1.0	EA
C4	611091	CAP,CER,22PF,25V	CN15C220J	71590	1.0	EA
J1	410396	CONN,PC RCPT,100 PIN	RCR50-6142-15	57856	1.0	EA
J7	410411	CONN,PC HDR,9 PIN	09-72-2091	27264	1.0	EA
J8	410401	CONN,PC RCPT,40 PIN	RC20-4242-5	57856	1.0	EA
J9	410401	CONN,PC RCPT,40 PIN	RC20-4242-5	57856	1.0	EA
J10	410401	CONN,PC RCPT,40 PIN	RC20-4242-5	57856	1.0	EA
J11	410401	CONN,PC RCPT,40 PIN	RC20-4242-5	57856	1.0	EA
J12	410402	CONN,PC HDR,4 PIN	22-12-2044	27264	1.0	EA
Q1	330321	TRANSISTOR,PWR,PNP,TO220A	TIP32C	04713	1.0	EA
R1	550259	RES,PWR,10W,330 OHM,5%	40J330	44655	1.0	EA
R2	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	EA
R3	570144	POT,MT,PC,100 OHM,1/4W	ET34P101	30983	1.0	EA
R4	560863	RES,FILM,1/8W,49.9 OHM1%	RN55C49R9F	81349	1.0	EA
R5	CIC522	RES,PREC,CIC522	CIC522	16067	1.0	EA
R6	CIC522	RES,PREC,CIC522	CIC522	16067	1.0	EA
R9	520057	RES,CARB,1/2W,10K OHM	RC20GF103J	81349	1.0	EA
U1	360217	IC,OP-AMP,FET,GP	LF356N	27014	1.0	EA
W1	250396	JUMPER BLOCK	15-29-1025	27264	1.0	EA
W2	250396	JUMPER BLOCK	15-29-1025	27264	1.0	EA
W3	250396	JUMPER BLOCK	15-29-1025	27264	1.0	EA
W4	250396	JUMPER BLOCK	15-29-1025	27264	1.0	EA
W5	FS5119	WIRE,BUS,AWG 22,QQ-W-343E	QQW343S22S2B	81348	1.0	IN
XU1	360230	SOCKET,DIP,08 PIN	ICO-083-S8-T	06776	1.0	EA
1	4000-763-1	PWB,MOTHER,4 HEATSINK	4000-763	16067	1.0	EA
2	210771	STANDOFF,SWGE,1/4-20X1/2*	G13326HB-10519*	51506	3.0	EA
3	210303	STANDOFF,SWGE,6-32 X 1/4	150B-1/4	88245	10.0	EA
4	FS1018	SCREW,PNH,S/S,4-40X1/2	MS51957-17	96906	2.0	EA
5	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	2.0	EA
6	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
7	4000-413-1	CABLE ASSY,RIBBON,34 PIN	4000-413	16067	1.0	EA
8	4000-417-1	CABLE ASSY,RIBBON,50 PIN	4000-417	16067	1.0	EA
9	4000-418-1	CABLE ASSY,OSCILLATOR	4000-418	16067	1.0	EA
10	4000-050-1	HARNESS ASSY	4000-050 REV B	16067	1.0	EA
11	250395	CONN,PC HDR,8 PIN	10-89-1081	27264	1.0	EA
12	4000-275-1	BRACKET,MTG,PC ASSY	4000-275	16067	1.0	EA
13	4000-276-2	BRACKET,MTG,PC ASSY	4000-276	16067	1.0	EA
14	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	2.0	EA
15	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	2.0	EA
16	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	2.0	EA
17	210834	STANDOFF,SWGE,6-32X3/16	3046D-632-A	55566	1.0	EA
18	4000-280-2	INSULATOR	4000-280-2	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C1	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C2	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C3	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C4	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C11	611123	CAP,MYLAR,.22UF,270V	912A1E224K	14752	1.0	EA
F1	270109	FUSE,1/8A,250V,SLO-BLO	313.125	75915	1.0	EA
J1	410352	CONN,PC HDR,16 PIN	09-72-1161	27264	1.0	EA
R1	550210	RES,PWR,7W,40 OHM,5%	RS-7-40 OHM	91637	1.0	EA
T1	4000-010-1	TRANSFORMER,BIAS	4000-010-1	16067	1.0	EA
1	4000-750-1	PWB,FILTER	4000-750-1	81349	1.0	EA
2	250314	FUSE CLIP,1/4",EAR	798	79963	2.0	EA
3	210771	STANDOFF,SWGE,1/4-20X1/2*	G13326HB-10519*	51506	4.0	EA
4	FS2025	LUG,S/O,F,CRMP,22/18-.110	S070909SF	14726	2.0	EA
5	FS5041	WIRE,BU,MIL-W-16878/4	AWG 18,WHT	81349	4.0	IN
6	310279	BRDG,RECT,TPFW,100A,200V	1000HT2U	59993	1.0	EA
7	FS1071	WASHER,INTER,S/S,#10	MS35333-73	96906	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C1	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C2	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C3	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C4	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C5	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C6	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C11	611123	CAP,MYLAR,.22UF,270V	912A1E224K	14752	1.0	EA
F1	270109	FUSE,1/8A,250V,SLO-BLO	313.125	75915	1.0	EA
J1	410352	CONN,PC HDR,16 PIN	09-72-1161	27264	1.0	EA
R1	550210	RES,PWR,7W,40 OHM,5%	RS-7-40 OHM	91637	1.0	EA
T1	4000-010-1	TRANSFORMER,BIAS	4000-010-1	16067	1.0	EA
1	4000-750-1	PWB,FILTER	4000-750-1	81349	1.0	EA
2	250314	FUSE CLIP,1/4",EAR	799	799o3	2.0	EA
3	210771	STANDOFF,SWGE,1/4-20X1/2*	G13326HB-10519*	51506	4.0	EA
4	FS2025	LUG,S/O,F,CRMP,22/18-.110	S070909SF	14726	2.0	EA
5	FS5041	WIRE,BU,MIL-W-16878/4	AWG 18,WHT	81349	4.0	IN
6	310279	BRDG,RECT,TPFW,100A,200V	1000HT2U	59993	1.0	EA
7	FS1071	WASHER,INTER,S/S,#10	MS35333-73	96906	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C1	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C2	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C3	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C4	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C5	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C6	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C7	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C8	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C11	611123	CAP,MYLAR,.22UF,270V	912A1E224K	14752	1.0	EA
F1	270109	FUSE,1/8A,250V,SLO-BLO	313.125	75915	1.0	EA
J1	410352	CONN,PC HDR,16 PIN	09-72-1161	27264	1.0	EA
R1	550210	RES,PWR,7W,40 OHM,5%	RS-7-40 OHM	91637	1.0	EA
T1	4000-010-1	TRANSFORMER,BIAS	4000-010-1	16067	1.0	EA
1	4000-750-1	PWB,FILTER	4000-750-1	81349	1.0	EA
2	250314	FUSE CLIP,1/4",EAR	798	79963	2.0	EA
3	210771	STANDOFF,SNGE,1/4-20X1/2*	G13326H3-10519*	51506	4.0	EA
4	FS2025	LUG,S/D,F,CRMP,22/18-.110	S070909SF	14726	2.0	EA
5	FS5041	WIRE,BU,MIL-W-16878/4	AWG 18,WHT	81349	4.0	IN
6	310279	BRDG,RECT,TPFW,100A,200V	100GHT2U	59993	1.0	EA
7	FS1071	WASHER,INTER,S/S,#10	MS35333-73	96906	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C1	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C2	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C3	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C4	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C5	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C6	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C7	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C8	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C9	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C10	611124	CAP,AL,9500UF,75V	3196DC952U075HM	80031	1.0	EA
C11	611123	CAP,MYLAR,.22UF,270V	912A1E224K	14752	1.0	EA
F1	270109	FUSE,1/8A,250V,SLO-BLO	313.125	75915	1.0	EA
J1	410352	CONN,PC HDR,16 PIN	09-72-1161	27264	1.0	EA
R1	550210	RES,PWR,7W,40 OHM,5%	PS-7-40 OHM	91637	1.0	EA
T1	4000-010-1	TRANSFORMER,BIAS	4000-010-1	16067	1.0	EA
1	4000-750-1	PWB,FILTER	4000-750-1	81349	1.0	EA
2	250314	FUSE CLIP,1/4",EAR	798	79963	2.0	EA
3	210771	STANDOFF,SWGE,1/4-20X1/2*	G13326HB-10519*	51505	4.0	EA
4	FS2025	LUG,S/O,F,CRMP,22/18-.110	S0709095F	14726	2.0	EA
5	FS5041	WIRE,BU,MIL-W-16878/4	AWG 18,wHT	81349	4.0	IN
6	310279	BRDG,RECT,TPEW,100A,200V	10004T2U	59993	1.0	EA
7	FS1071	WASHER,INTER,S/S,#10	MS35333-73	96906	2.0	EA

ENT ITEM NO.
0-401-1

HEATSINK ASSY,PWR AMP
ENGR DRAW NO. 4000-401 REV B

	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
2	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
3	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
4	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
5	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
6	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
7	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
8	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
1	360462	IC,ANA,TEMP TRANSDUCER	AD592AN	24355	1.0	EA
1	FS5122	WIRE,BUS,AWG 16,QQ-W-343E	QQW343S16S2B	81348	1.0	IN
1	4000-709-1	PC ASSY,POWER AMP	4000-709 REV	16067	1.0	EA
2	4000-761-1	PWB,JUMPER BOARD	4000-761-1	16067	1.0	EA
3	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	6.0	EA
4	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	6.0	EA
5	4000-222-1	HEATSINK,AMPLIFIER	4000-222-1	16067	1.0	EA
6	210779	SCREW,CTG,PNH,CAD,6X1/2	#6 X 1/2 TYPE B	81349	16.0	EA
7	FS1028	SCREW,PNH,S/S,6-32X5/16	MS51957-27	81349	1.0	EA
8	210780	HEATSINK,TO92	RUR67B1CB	98978	1.0	EA
9	FS1069	WASHER,INTER,S/S,#6	MS35333-71	96906	1.0	EA
10	210781	INSULATOR,SIL-PAD,TO3	1009-05	0008F	1.0	EA
11	FS4001	THERMAL COMPOUND	351	13103	1.0	OZ

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NUMBER	VENDOR	QTY	UM
CR1	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR2	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR3	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR4	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR5	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR6	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR7	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR8	310062	DIODE,RECT,1A,400V,DO41	1N4004	04713	1.0	EA
CR9	310280	DIODE,RECT,24A,200V	AR2402	72699	1.0	EA
J1	410392	CONN,PC,RT ANGLE, 40 PIN	PR20-6101-5	000BE	1.0	EA
R1	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R2	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R3	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R4	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R5	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R6	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R7	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R8	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R9	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R10	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R11	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R12	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R13	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R14	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R15	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R16	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
R17	4000-020-1	RES,PWR,5W,.2 OHM,5%	4000-020-1	33901	1.0	EA
1	4000-759-1	PWB,POWER AMP	4000-759-1	16067	1.0	EA
2	210303	STANDOFF,SWGE,6-32 X 1/4	1508-1/4	88245	8.0	EA
3	250411	SOCKET,XSTR,TO-3	1001-11	000BD	8.0	EA
4	250418	SOCKET,PC COMPONENT LEAD	1-380759-0	00779	3.0	EA

EQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	4000-401-1	HEATSINK ASSY,PWR AMP	4000-401 REV B	16067	1.0	EA

EQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
1	4000-401-1	HEATSINK ASSY,PWR AMP	4000-401 REV B	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED		ENGINEERING DRAWING NO.	VENDOR	QTY	UM
A3	4000-710-1	PC ASSY,PREAMP/PWR SUP		4000-710 REV F	16067	1.0	EA
C1	610302	CAP,MICA,1500PF,500V		CM06F152J03	81349	1.0	EA
C2	610730	CAP,CER,1000PF,1000V		DD102	71590	1.0	EA
C4	610072	CAP,CER,3300PF,100V		DD332	71590	1.0	EA
C5	610620	CAP,MICA,250PF,500V		CM05F251J03	81349	1.0	EA
C8	610027	CAP,MICA,100PF,500V		CM05F101J03	81349	1.0	EA
C69	610929	CAP,MYLAR,.01UF,250V	1	712A1BP103PK40*	80031	1.0	EA
C70	610062	CAP,CER,1000PF,1000V		5HK-D10	56289	1.0	EA
R1	560763	RES,FILM,1/8W,6.19K,1%		RN55D6191F	81349	1.0	EA
R2	560763	RES,FILM,1/8W,6.19K,1%		RN55D6191F	81349	1.0	EA
R9	560496	RES,FILM,1/4W,68.1K,1%		RN60E6812F	81349	1.0	EA
R21	560575	RES,FILM,1/8W,33.2K,1%		RN55D3322F	81349	1.0	EA
R48	560782	RES,FILM,1/8W,191K,1%		RN55D1913F	81349	1.0	EA
R49	560782	RES,FILM,1/8W,191K,1%		RN55D1913F	81349	1.0	EA
R93	510030	RES,CARB,1/4W,15K OHM		RC07GF153J	81349	1.0	EA
R113	560879	RES,FILM,1/8W,2.21K,1%		RN55D2211F	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR1	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR2	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR3	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR4	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR5	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR6	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR7	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR8	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR9	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR10	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR11	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR12	310062	DIODE,RECT,1A,400V,DO41	1N4004	81349	1.0	EA
CR13	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR14	310067	DIODE,ZNR,15V,.5W,5%	1N5245B	04713	1.0	EA
CR15	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR16	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR17	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR18	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR19	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR20	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR21	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
CR22	310169	DIODE,ZNR,10V,.5W,5%	1N5240B	04713	1.0	EA
CR23	310175	DIODE,ZNR,4.7V,.5W,5%	1N5230B	04713	1.0	EA
R24	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R25	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R26	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R27	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R28	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R29	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R30	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R31	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R34	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R35	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R37	310281	BRDG,RECT,FW,4A,200V	MDA970A3	04713	1.0	EA
R38	310254	BRDG,RECT,FW,1A,200V,DIP	VM28	27683	1.0	EA
R39	310281	BRDG,RECT,FW,4A,200V	MDA970A3	04713	1.0	EA
R40	310254	BRDG,RECT,FW,1A,200V,DIP	VM28	27683	1.0	EA
R41	310254	BRDG,RECT,FW,1A,200V,DIP	VM28	27683	1.0	EA
R42	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R43	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R44	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R45	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R46	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R47	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R48	310227	DIODE,SWNG,75V,.5W,DO35	1N4148	81349	1.0	EA
R49	310262	DIODE,FRCVY,1A,50V	MR810	04713	1.0	EA
R50	310262	DIODE,FRCVY,1A,50V	MR810	04713	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED		ENGINEERING DRAWING NO.	VENDOR	QTY	UM
CR51	310062	DIODE,RECT,1A,400V,DO41		1N4004	81349	1.0	EA
CR52	310227	DIODE,SWNG,75V,.5W,DO35		1N4148	81349	1.0	EA
CR53	310227	DIODE,SWNG,75V,.5W,DO35		1N4148	81349	1.0	EA
CR54	310227	DIODE,SWNG,75V,.5W,DO35		1N4148	81349	1.0	EA
C3	610796	CAP,TANT,1UF,35V		T362A105M035AS	05397	1.0	EA
C6	610808	CAP,TANT,.22UF,50V		T362A224M050AS	05397	1.0	EA
C7	610027	CAP,MICA,100PF,500V		CM05FI01J03	81349	1.0	EA
C9	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C10	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C11	610062	CAP,CER,1000PF,1000V		5HK-D10	56289	1.0	EA
C12	610062	CAP,CER,1000PF,1000V		5HK-D10	56289	1.0	EA
C16	610798	CAP,TANT,2.2UF,25V		T362B225M025AS	05397	1.0	EA
C17	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C18	610721	CAP,MYLAR,1UF,100V		112A1B105M	14752	1.0	EA
C19	611119	CAP,AL,15000UF,16V		80D153P016MB2	56289	1.0	EA
C20	611119	CAP,AL,15000UF,16V		80D153P016MB2	56289	1.0	EA
C21	611121	CAP,AL,1000UF,35V		503D108M035QE	56289	1.0	EA
C22	611121	CAP,AL,1000UF,35V		503D108M035QE	56289	1.0	EA
C23	611120	CAP,AL,1800UF,80V		80D182P080KB2	56289	1.0	EA
C24	611120	CAP,AL,1800UF,80V		80D182P080KB2	56289	1.0	EA
C25	611120	CAP,AL,1800UF,80V		80D182P080KB2	56289	1.0	EA
C26	611120	CAP,AL,1800UF,80V		80D182P080KB2	56289	1.0	EA
C27	610852	CAP,TANT,47UF,35V		T362D476M035AS	05397	1.0	EA
C28	611121	CAP,AL,1000UF,35V		503D108M035QE	56289	1.0	EA
C29	610094	CAP,CER,.01UF,50V		CK103	71590	1.0	EA
C30	610750	CAP,TANT,4.7UF,10V		T362A475M010AS	05397	1.0	EA
C31	610094	CAP,CER,.01UF,50V		CK103	71590	1.0	EA
C32	610760	CAP,TANT,1UF,50V		T36A105M050AS	05397	1.0	EA
C33	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C34	610730	CAP,CER,1000PF,1000V		DD102	71590	1.0	EA
C35	610094	CAP,CER,.01UF,50V		CK103	71590	1.0	EA
C36	610094	CAP,CER,.01UF,50V		CK103	71590	1.0	EA
C37	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C38	610730	CAP,CER,1000PF,1000V		DD102	71590	1.0	EA
C39	610796	CAP,TANT,1UF,35V		T362A105M035AS	05397	1.0	EA
C40	610798	CAP,TANT,2.2UF,25V		T362B225M025AS	05397	1.0	EA
C41	611082	CAP,MYLAR,.1UF,100V	*	712A1BC104PK*	80031	1.0	EA
C42	610015	CAP,MICA,50PF,50CV		DM15-500J	72136	1.0	EA
C43	611122	CAP,MYLAR,6.8UF,50V		11AA685K	000BH	1.0	EA
C44	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C45	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C46	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C47	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C49	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C50	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C51	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA
C55	611103	CAP,CER,.1UF,50V,Z5U		CZ20C104M	71590	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
C56	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C57	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C58	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C59	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C61	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C62	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C63	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C64	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C66	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C67	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
C68	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
C71	610268	CAP,MICA,47PF,500V	CM05E470J03	81349	1.0	EA
C72	610268	CAP,MICA,47PF,500V	CM05E470J03	81349	1.0	EA
C73	610094	CAP,CER,.01UF,50V	CK103	71590	1.0	EA
C74	610730	CAP,CER,1000PF,1000V	DD102	71590	1.0	EA
C75	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C76	611103	CAP,CER,.1UF,50V,Z5U	CZ20C104M	71590	1.0	EA
C77	611089	CAP,CER,47PF,25V	CN15C470K	71590	1.0	EA
C78	610030	CAP,MICA,150PF,500V	CM05F151J03	81349	1.0	EA
C79	610750	CAP,TANT,4.7UF,10V	T362A475M010AS	05397	1.0	EA
C80	610750	CAP,TANT,4.7UF,10V	T362A475M010AS	05397	1.0	EA
C81	610796	CAP,TANT,1UF,35V	T362A105M035AS	05397	1.0	EA
DS1	230080	LAMP,LED,GREEN	5032-4950	01295	1.0	EA
J1	410393	CONN,PC ST PLUG 100 PIN	PS50-4102-5	57856	1.0	EA
Q1	330324	TRANSISTOR,SS,NPN,TO92	MPSA42	04713	1.0	EA
Q2	330325	TRANSISTOR,SS,PNP,TO92	MPSA92	04713	1.0	EA
Q3	330318	TRANSISTOR,PWR,NPN,TO202	MDS-21	04713	1.0	EA
Q4	330325	TRANSISTOR,SS,PNP,TO92	MPSA92	04713	1.0	EA
Q5	330324	TRANSISTOR,SS,NPN,TO92	MPSA42	04713	1.0	EA
Q6	330314	TRANSISTOR,PWR,PNP,TO202	MDS60	04713	1.0	EA
Q7	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
Q8	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q9	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q10	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
Q11	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
Q12	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q13	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q14	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q15	330317	TRANSISTOR,PWR,NPN,TO3	MJ15022	04713	1.0	EA
Q16	330315	TRANSISTOR,PWR,PNP,TO3	MJ15023	04713	1.0	EA
Q17	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q18	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q19	330285	TRANSISTOR,SS,PNP,TO92	PN2907A	07263	1.0	EA
Q20	330289	TRANSISTOR,SS,NPN,TO92	PE8050	07263	1.0	EA
Q21	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
Q22	330284	TRANSISTOR,SS,NPN,TO92	PN2222A	07263	1.0	EA
R3	560902	RES,FILM,1/8W,86.6K,1%	RN55C8662F	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R4	560836	RES,FILM,1/8W,1M,1%	RN55C1004F	81349	1.0	EA
R5	570287	POT,1T,PC,5K,3/4,10%	62-1-2-502	02111	1.0	EA
R10	560661	RES,FILM,1/4W,82.5K,1%	RN60C8252F	81349	1.0	EA
R11	560752	RES,FILM,1/8W,4.75K,1%	RN55C4751F	81349	1.0	EA
R12	560823	RES,FILM,1/8W,11.0K,1%	RN55D1102F	81349	1.0	EA
R13	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R14	510004	RES,CARB,1/4W,7.5 OHM	RC07GF7R5J	81349	1.0	EA
R15	560859	RES,FILM,1/8W,150K,1%	RN55C1503F	81349	1.0	EA
R16	560837	RES,FILM,1/8W,47.5K,1%	RN55C4752F	81349	1.0	EA
R17	510104	RES,CARB,1/4W,150K OHM	RC07GF154J	81349	1.0	EA
R18	560823	RES,FILM,1/8W,11.0K,1%	RN55D1102F	81349	1.0	EA
R19	560858	RES,FILM,1/8W,28.0K,1%	RN55C2802F	81349	1.0	EA
R20	510086	RES,CARB,1/4W,27K OHM	RC07GF273J	81349	1.0	EA
R22	560573	RES,FILM,1/8W,100K,1%	RN55D1003F	81349	1.0	EA
R23	530080	RES,CARB,1W,33 OHM	RC32GF330J	81349	1.0	EA
R24	530001	RES,CARB,1W,10 OHM	RC32GF100J	81349	1.0	EA
R25	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	EA
R26	510123	RES,CARB,1/4W,1M OHM	RC07GF105J	81349	1.0	EA
R27	560874	RES,FILM,1/8W,165K,1%	RN55D1653F	81349	1.0	EA
R28	560873	RES,FILM,1/8W,237K,1%	RN55D2373F	81349	1.0	EA
R29	560796	RES,FILM,1/8W,49.9K,1%	RN55D4992F	81349	1.0	EA
R30	560796	RES,FILM,1/8W,49.9K,1%	RN55D4992F	81349	1.0	EA
R31	560840	RES,FILM,1/8W,110K,1%	RN55C1103F	81349	1.0	EA
R32	510080	RES,CARB,1/4W,15K OHM	RC07GF153J	81349	1.0	EA
R33	510135	RES,CARB,1/4W,10M OHM	RC07GF106J	81349	1.0	EA
R34	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R35	510004	RES,CARB,1/4W,7.5 OHM	RC07GF7R5J	81349	1.0	EA
R36	530080	RES,CARB,1W,33 OHM	RC32GF330J	81349	1.0	EA
R37	510123	RES,CARB,1/4W,1M OHM	RC07GF105J	81349	1.0	EA
R38	560875	RES,FILM,1/8W,221 OHM,1%	RN55D2210F	81349	1.0	EA
R39	560795	RES,FILM,1/8W,309K,1%	RN55D3093F	81349	1.0	EA
R40	560842	RES,FILM,1/8W,316K,1%	RN55C3163F	81349	1.0	EA
R41	560573	RES,FILM,1/8W,100K,1%	RN55D1003F	81349	1.0	EA
R42	560573	RES,FILM,1/8W,100K,1%	RN55D1003F	81349	1.0	EA
R43	560573	RES,FILM,1/8W,100K,1%	RN55D1003F	81349	1.0	EA
R44	510130	RES,CARB,1/4W,4.74 OHM	RC07GF475J	81349	1.0	EA
R45	560826	RES,FILM,1/8W,36.5K,1%	RN55D3652F	81349	1.0	EA
R46	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	EA
R47	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	EA
R50	560739	RES,FILM,1/8W,66.5K,.1%	RN55E6652B	81349	1.0	EA
R51	560823	RES,FILM,1/8W,11.0K,1%	RN55D1102F	81349	1.0	EA
R52	560745	RES,FILM,1/8W,442K,1%	RN55D4423F	81349	1.0	EA
R53	560791	RES,FILM,1/8W,30.1K,1%	RN55D3012F	81349	1.0	EA
R54	560793	RES,FILM,1/8W,562K,1%	RN55D5623F	81349	1.0	EA
R55	560796	RES,FILM,1/8W,49.9K,1%	RN55D4992F	81349	1.0	EA
R56	560793	RES,FILM,1/8W,562K,1%	RN55D5623F	81349	1.0	EA
R57	560745	RES,FILM,1/8W,442K,1%	RN55D4423F	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R58	560796	RES,FILM,1/8W,49.9K,1%	RN55D4992F	81349	1.0	EA
R59	560823	RES,FILM,1/8W,11.0K,1%	RN55D1102F	81349	1.0	EA
R60	560793	RES,FILM,1/8W,562K,1%	RN55D5623F	81349	1.0	EA
R61	560845	RES,FILM,1/8W,60.4K,1%	RN55C6042F	81349	1.0	EA
R62	560845	RES,FILM,1/8W,60.4K,1%	RN55C6042F	81349	1.0	EA
R63	510083	RES,CARB,1/4W,20K OHM	RC07GF203J	81349	1.0	EA
R65	560876	RES,FILM,1/8W,750K,1%	RN55D7503F	81349	1.0	EA
R67	510100	RES,CARB,1/4W,100K OHM	RC07GF104J	81349	1.0	EA
R72	560756	RES,FILM,1/8W,12.1K,1%	RN55C1212F	81349	1.0	EA
R73	560756	RES,FILM,1/8W,12.1K,1%	RN55C1212F	81349	1.0	EA
R74	560575	RES,FILM,1/8W,33.2K,1%	RN55D3322F	81349	1.0	EA
R77	560410	RES,FILM,1/4W,5.62K,1%	RN60C5621F	81349	1.0	EA
R78	510086	RES,CARB,1/4W,27K OHM	RC07GF273J	81349	1.0	EA
R79	560823	RES,FILM,1/8W,11.0K,1%	RN55D1102F	81349	1.0	EA
R80	560751	RES,FILM,1/8W,93.1K,1%	RN55D9312F	81349	1.0	EA
R81	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R82	560861	RES,FILM,1/8W,15.4K,1%	RN55C1542F	81349	1.0	EA
R83	560770	RES,FILM,1/8W,1K,1%	RN55D1001F	81349	1.0	EA
R84	560888	RES,FILM,1/8W,1.43K,1%	RN55D1431F	81349	1.0	EA
R85	510108	RES,CARB,1/4W,220K OHM	RC07GF224J	81349	1.0	EA
R86	510144	RES,CARB,1/4W,1.5M OHM	RC07GF155J	81349	1.0	EA
R87	510078	RES,CARB,1/4W,12K OHM	RC07GF123J	81349	1.0	EA
R88	510005	RES,CARB,1/4W,10 OHM	RC07GF100J	81349	1.0	EA
R89	570260	POT,1T,PC,5K	63P502	02111	1.0	EA
R90	560074	RES,FILM,1/4W,8.25K,1%	RN60D8251F	81349	1.0	EA
R91	510076	RES,CARB,1/4W,10K OHM	RC07GF103J	81349	1.0	EA
R92	510064	RES,CARB,1/4W,3.3K OHM	RC07GF332J	81349	1.0	EA
R94	510092	RES,CARB,1/4W,47K OHM	RC07GF473J	81349	1.0	EA
R95	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	EA
R96	560834	RES,FILM,1/8W,2.74K,1%	RN55C2741F	81349	1.0	EA
R97	560756	RES,FILM,1/8W,12.1K,1%	RN55C1212F	81349	1.0	EA
R98	560886	RES,FILM,1/8W,17.8K,1%	RN55D1782F	81349	1.0	EA
R99	510120	RES,CARB,1/4W,750K OHM	RC07GF754J	81349	1.0	EA
R100	510112	RES,CARB,1/4W,330K OHM	RC07GF334J	81349	1.0	EA
R101	560800	RES,FILM,1/8W,75K,1%	RN55D7502F	81349	1.0	EA
R102	510017	RES,CARB,1/4W,33 OHM	RC07GF330J	81349	1.0	EA
R103	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	EA
R104	510017	RES,CARB,1/4W,33 OHM	RC07GF330J	81349	1.0	EA
R105	510045	RES,CARB,1/4W,470 OHM	RC07GF471J	81349	1.0	EA
R106	510053	RES,CARB,1/4W,1K OHM	RC07GF102J	81349	1.0	EA
R107	560871	RES,FILM,1/8W,3.32K 1%	RN55D3321F	81349	1.0	EA
R108	550260	RES,PWR,3W,4.7K,5%	RSF3B-4.7K	56637	1.0	EA
R109	550260	RES,PWR,3W,4.7K,5%	RSF3B-4.7K	56637	1.0	EA
R110	510072	RES,CARB,1/4W,6.8K OHM	RC07GF682J	81349	1.0	EA
R111	560857	RES,FILM,1/8W,42.2K,1%	RN55C4222F	81349	1.0	EA
R112	510029	RES,CARB,1/4W,100 OHM	RC07GF101J	81349	1.0	EA
R114	560760	RES,FILM,1/8W,12.4K,1%	RN55C1242F	81349	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
R115	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	EA
R116	510165	RES,CARB,1/4W,1 OHM	RC07GF1R0J	81349	1.0	EA
R118	560880	RES,FILM,1/8W,6.65K,1%	RN55D6651F	81349	1.0	EA
R119	560880	RES,FILM,1/8W,6.65K,1%	RN55D6651F	81349	1.0	EA
R120	510033	RES,CARB,1/4W,150 OHM	RC07GF151J	81349	1.0	EA
R121	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	EA
R122	560762	RES,FILM,1/8W,10K,1%	RN55D1002F	81349	1.0	EA
R123	510038	RES,CARB,1/4W,33K OHM	RC07GF333J	81349	1.0	EA
R124	510060	RES,CARB,1/4W,2.2K OHM	RC07GF222J	81349	1.0	EA
R127	510092	RES,CARB,1/4W,47K OHM	RC07GF473J	81349	1.0	EA
R128	560833	RES,FILM,1/8W,825K,1%	RN55C8253F	81349	1.0	EA
TP1	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP2	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP3	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP4	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP5	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP6	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP7	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP8	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP9	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP10	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP11	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP12	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP13	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP14	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP15	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP16	250303	TERMINAL,MINIWRAP POST	T44	82893	1.0	EA
TP17	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
TP18	210724	TERMINAL,QCK CLP,PC,MALE	835	79963	1.0	EA
T1	710359	TRANSFORMER	11Z2103	56289	1.0	EA
U1	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U2	360309	IC,OPTO,COUPLER,FET	H11F2	09214	1.0	EA
U3	360307	IC,OP-AMP,FET,PREC	LF411	27014	1.0	EA
U4	360308	IC,ANA,TRANSCOND,DUAL	CA3230AG	18722	1.0	EA
U5	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U6	360219	IC,COMPARATOR,DUAL	LM393N	27014	1.0	EA
U7	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U8	360163	IC,MOS,EXCL OR,2-IN,QUAD	CD4070BE	18722	1.0	EA
U9	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U10	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U11	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U12	360213	IC,OP-AMP,FET,DUAL	LF353N	27014	1.0	EA
U13	360194	IC,OP-AMP,DUAL,LP	LM358N	27014	1.0	EA
U14	360309	IC,OPTO,COUPLER,FET	H11F2	09214	1.0	EA
U22	360218	IC,COMPARATOR,QUAD	LM339N	27014	1.0	EA
U24	360029	IC,OP-AMP,GP	LM201AN	27014	1.0	EA
U25	360463	IC,TIMER,DUAL	ICM7556IPD	32293	1.0	EA

USED NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
VR1	310016	DIODE,ZNR,6.2V,.4W,5%	1N753A	04713	1.0	EA
VR2	310129	DIODE,ZNR,3.3V,.5W,5%	1N5226B	04713	1.0	EA
VR4	310269	IC,VOLTAGE,REG,+VAR	TL 431 CLP	01295	1.0	EA
VR5	310269	IC,VOLTAGE,REG,+VAR	TL 431 CLP	01295	1.0	EA
VR6	310269	IC,VOLTAGE,REG,+VAR	TL 431 CLP	01295	1.0	EA
VR7	310269	IC,VOLTAGE,REG,+VAR	TL 431 CLP	01295	1.0	EA
VR8	360032	IC,VOLTAGE REG,+5,1A	LM340-5T	27014	1.0	EA
VR9	360251	IC,VOLTAGE REG,+15,1A	MC7815CT	04713	1.0	EA
VR10	360252	IC,VOLTAGE REG,-15,1A	MC7915CT	04713	1.0	EA
VR11	360251	IC,VOLTAGE REG,+15,1A	MC7815CT	04713	1.0	EA
VR12	310269	IC,VOLTAGE,REG,+VAR	TL 431 CLP	01295	1.0	EA
VR13	310269	IC,VOLTAGE,REG,+VAR	TL 431 CLP	01295	1.0	EA
VR14	310196	DIODE,ZNR,6.8V,.5W,5%	1N5235B	04713	1.0	EA
VR15	310196	DIODE,ZNR,6.8V,.5W,5%	1N5235B	04713	1.0	EA
W1	250396	JUMPER BLOCK	15-29-1025	27264	1.0	EA
Z1	360448	RES,ARRAY,TFLM,DIP,1K	699-3-R1K-F	73138	1.0	EA
Z2	360449	RES,ARRAY,SIP,100K	1068104	01121	1.0	EA
Z3	360450	RES,ARRAY,SIP,10K	1108103	01121	1.0	EA
Z4	360451	RES,ARRAY,SIP,4.7K	1068472	01121	1.0	EA
Z5	360452	RES,ARRAY,SIP,2.2K	1088222	01121	1.0	EA
Z6	360453	RES,ARRAY,SIP,470 OHM	1108471	01121	1.0	EA
Z7	360454	RES,ARRAY,SIP,10K	1088103	01121	1.0	EA
Z8	360455	RES,ARRAY,TFLM,DIP,10K	699-3-10K-F	73138	1.0	EA
Z9	360456	RES,ARRAY,TFLM,DIP,100K	694-3-100K-F	73138	1.0	EA
Z10	360457	RES,ARRAY,SIP,1K	1068102	01121	1.0	EA
Z11	360458	RES,ARRAY,TFLM,DIP,10K	698-3-10K-F	73138	1.0	EA
Z12	360460	RES,ARRAY,SIP,22K	1068223	01121	1.0	EA
Z13	360459	RES,ARRAY,SIP,,4.7K	1108472	01121	1.0	EA
Z14	360450	RES,ARRAY,SIP,10K	1108103	01121	1.0	EA
Z15	360460	RES,ARRAY,SIP,22K	1068223	01121	1.0	EA
1	4000-760-1	PWB,PRE AMP/PWR SUP	4000-760-1	16067	1.0	EA
2	FS1018	SCREW,PNH,S/S,4-40X1/2	MS51957-17	96906	2.0	EA
3	FS1073	WASHER,SPLT,S/S,#6	MS35338-136	96906	16.0	EA
4	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	16.0	EA
5	210759	HEATSINK,TO3	689-125-3-2	05820	2.0	EA
6	210734	HEATSINK,TO3	61033	13103	2.0	EA
7	FS1031	SCREW,PNH,S/S,6-32X7/16	MS51957-29	81349	16.0	EA
8	250395	CONN,PC HDR,8 PIN	10-89-1081	27264	1.0	EA
9	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
10	FS1072	WASHER,SPLT,S/S,#4	MS35338-135	96906	2.0	EA
11	FS4001	THERMAL COMPOUND	351	13103	.1	OZ
12	210737	HEATSINK,TO220	LAE66A2CB	98978	1.0	EA
13	FS1030	SCREW,PNH,S/S,6-32X3/8	MS51957-28	96906	2.0	EA
14	FS1064	NUT,HEX,S/S,6-32	MS35649-264	96906	2.0	EA
15	FS1077	WASHER,EXTER,S/S,#6	MS35335-58	81349	2.0	EA
16	210329	HEATSINK,TO220	288-2-A3	05820	2.0	EA
17	FS1011	SCREW,PNH,S/S,4-40X1/4	MS51957-13	96906	2.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
18	FS1066	NUT,HEX,S/S,4-40	MS35649-244	96906	2.0	EA
19	FS4014	TAPE,FOAM,DOUBLE ADHESIVE	3/4WIDEX1/8DEEP	81349	15.0	IN
20	4000-282-1	SHIELDING PAPER	4000-282-1	16067	1.0	EA

SEQ NO.	COMPONENT ITEM NO.	DESCRIPTION TRUNCATED	ENGINEERING DRAWING NO.	VENDOR	QTY	UM
J1	410400	CONN,PC,VERT MT,50PIN	552118-1	00779	1.0	EA
J2	410418	CONN,PC HDR,50 PIN	PS25-4102-0-19	57856	1.0	EA
S1	240508	SWITCH,RTRY,PC,3POL,3POS	MRSB-3-3-PC	95146	1.0	EA
1	4000-765-1	PWB,PHASE SELECTOR SW	4000-765-1	16067	1.0	EA
2	210795	STANDOFF,SWGE,6-32X3/8	9535B-SS-0632	06540	2.0	EA

Appendix A

Code	Name	City	State
0000A	Electricord	Westfield	PA
0000C	Jackson Bros.	Waddon, Surrey	GB
0000S	DPCDA	Edison	NJ
0000W	Milton Ross Co.	Southampton	PA
0000Z	Timco	Los Angeles	CA
000AC	ITAC	Santa Clara	CA
000AD	Pleasey	Westlake Village	CA
000AG	La France	Philadelphia	PA
000AH	Jan Crystal	Ft. Myers	CA
000AL	Data Components, Inc.	Santa Monica	CA
000AM	Kraus & Naimer	Santa Monica	CA
000AN	Ritz Instrument Transformer Co.	Redondo Beach	CA
000AS	Switches Incorporated	Mt. View	CA
00544	Metal-Cal Div., Avery Prod. Corp.	Inglewood	CA
00779	AMP Inc.	Harrisburg	PA
00833	Sangamo Electric Co.	Pickens	SC
00866	Goe Eng. Co., Inc.	City of Industry	CA
01002	G.E. Co., Ind. & Pwr. Cap. Dept.	John St. Hudson Falls	NY
01121	Allen-Bradley Co.	Milwaukee	WI
01139	G.E. Co., Silicone Products Dept.	Waterford	NY
01295	Texas Instruments	Dallas	TX
02111	Spectrol Electronics	City of Industry	CA
02333	Fairchild Controls Corp.	Hicksville, LI	NY
02375	American Insulating Machinery Co.	Philadelphia	PA
02538	Texas Electronics Co.	Dallas	TX
02660	Amphenol Corporation	Broadview	IL
02799	Use Code #72136		
03307	General Electric Company	Syracuse	NY
03308	General Electric Company	Syracuse	NY
03797	Eldema Corporation	Compton	CA
03888	Pyrofile Resistor Co., Inc.	Cedar Knolls	NJ
03911	Clairex Corporation	New York	NY
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford	CT
04713	Motorola Semiconductor Prod., Inc.	Phoenix	AZ
04963	3-M	St. Paul	MN
05245	Corcom Inc.	Chicago	IL
05276	Pomona Electronics Co., Inc.	Pomona	CA
05397	Kemet, Union Carbide Corp.	Cleveland	OH
05820	Wakefield Engineering, Inc.	Wakefield	MA
06383	Panduit Corp.	Tinley Park	IL
06514	Stantron, Wyco Metal Products	N. Hollywood	CA
06540	Amathom Elect. Hardware	New Rochelle	NY
06665	Precision Monolithics Inc.	Santa Clara	CA
06776	Robinson Nugent, Inc.	New Albany	IN
06915	Richco Plastics, Co.	Chicago	IL
07088	Kelvin Electric Company	Van Nuys	CA
07263	Fairchild Camera and Instr. Corp.	Mt. View	CA
07387	Birtcher Corporation	Los Angeles	CA
07556	Unitrack Calabro Plastics	Upper Darby	PA
07633	Epoxy Prod. Co., Allied Prod. Corp.	New Haven	CT
07716	IRC Incorporated	Burrington	IA
08065	Accurate Rubber and Plastics Co.	San Diego	CA
08261	Spectra Strip	Garden Grove	
13103	Thermalloy Company	Dallas	TX
14099	Semtech Corporation	Newbury Park	CA
14604	Elmwood Sensors Inc.	Cranston	RI
14655	Cornell-Dubilier Elect. Corp.	Newark	NJ
14726	Hollingsworth Co.	Phoenixville	PA
14752	Electro Cube, Incorporated	San Gabriel	CA
15238	ITT Semiconductors	Lawrence	MA
15636	Elec-trol	Northridge	CA
15801	Fenwall Electronics	Framingham	MA
15818	Amelco Teledyne, Incorporated	Mt. View	CA
15912	Ansley	Los Angeles	CA
16067	California Instruments Company	San Diego	CA
16758	Delco Radio Div., General Motors	Kokomo	IN
16936	Dennison	Framingham	MS
18076	Vapco	City of Industry	CA
18178	Vactec, Inc.	Maryland Heights	Mo
18324	Signetics	Sunnyvale	CA
18612	Vishay Instruments Inc.	Malvern	PA
18677	Bcambe Mfg. Co.	Monterey Park	CA
18722	RCA	Mountaintop	PA
18736	Voltronics Corp.	Hanover	NJ
19080	The Robinson Company	Hawthorne	CA
21604	Buckeye Stamping Company	Columbus	OH
22599	Elastic Stop Nut Corporation	Van Nuys	CA
23050	Product Components Corp.	Hastings-on-Hudson	NY
23936	Panotor, Incorporated	San Francisco	CA
24011	ECC	Burlington	MA
24444	General Semiconductor Industries Inc.	Tempe	AZ
24796	Paralco Inc.	Paramount	CA
25497	Meter Master	Los Angeles	CA
26806	American Zettler, Inc.	Costa Mesa	CA
27014	National Semi-Conductor Corp.	Santa Clara	CA
27191	Cutler-Hammer, Inc.	Milwaukee	WI
27264	Molex	Downers Grove	IL
27556	IMB Electronic Products	Santa Fe Springs	CA
27683	Varo, Incorporated	St. Garland	TX
27832	Hughes Aircraft	Newport Beach	CA

Code	Name	City	State
28480	Hewlett-Packard Co.	Palo Alto	CA
28520	Heyman Mfg. Company (Heyco)	Kenilworth	NJ
30039	International Components Corp.	Asbury Park	NJ
30983	Electra/Midland (Mepco/Electra)	San Diego	CA
30161	Aavid Engineering Inc.	Laconia	NH
30897	Dprann Company	Sylmar	CA
31931	Tririge Inc.	Pittsburgh	PA
32293	Intersil	Cupertino	CA
32559	Bivar, Inc.	Santa Ana	CA
33003	Jewell Electrical Instruments Inc.	Manchester	NH
33716	Kingsbacher Murray Co.	Los Angeles	CA
33855	Ducommun Inc.	Los Angeles	CA
34333	Silicon General	Westminster	CA
34649	Intel Corporation	Santa Clara	CA
44655	Ohmite Manufacturing Company	Skokie	IL
45722	Parker-Kalon	Clifton	NJ
46384	Penn. Eng. and Mfg. Corp.	Doylestown	PA
50522	Monsanto, Electronic Special Products	Cupertino	CA
51167	Arlen Electronics Inc.	Frenchtown	NJ
51705	ICO/Rally	Palo Alto	CA
52072	Circuit Assembly Corp.	Costa Mesa	CA
54407	Power-One Co.	Camarillo	CA
56289	Sprague Electric Company	North Adams	MA
58474	Superior Electric Company	Bristol	CT
59730	Thomas and Betts Company	Elizabeth	NJ
63743	Ward Leonard Electric Co.	Mt. Vernon	NY
70318	Allmetal Screw Prod. Co.	Garden City	NY
70903	Belden Manufacturing Co.	Chicago	IL
71218	Bud Industries, Inc.	Willoughby	OH
71279	Cambridge Thermionic Corp.	Cambridge	MA
71400	Bussman Mfg. Div. McGraw-Edison Co.	St. Louis	MO
71450	CTS Corporation	Elkhart	IN
71468	ITT Cannon Electric Inc.	Los Angeles	CA
71590	Centralab Div. Globe-Union, Inc.	Milwaukee	WI
71707	Coto-Coil	Providence	RI
71744	Chicago Miniature Lampworks	Chicago	IL
71785	Cinch Manufacturing Company	Chicago	IL
71984	Dow Corning Corp.	Midland	MI
72136	Elmenco (Electro Motive)	Willimantic	CT
72619	Dialight Corporation	Brooklyn	NY
72699	General Instruments	Newark	NJ
72982	Erie Technological Products Inc.	Erie	PA
73138	Beckman Instruments, Inc.	Fullerton	CA
73734	Federal Screw Products, Inc.	Chicago	IL
74193	Heinemann Electric Company	Trenton	NJ
74545	Harvey Hubbell, Inc.	Bridgeport	CT
74840	Illinois Condenser Co.	Chicago	IL
74970	E.F. Johnson Company	Waseca	MN
75042	TRW Electronic Components	Philadelphia	PA
75382	Kulka Electric Corporation	Mt. Vernon	NY
75915	Littlefuse Incorporated	Des Plaines	IL
77132	United-Carr Inc., Patwin Division	Waterbury	CT
77342	Potter and Brumfield Div., AMF	E. Princeton	IN
78189	Shakeproof Div., Illinois Tool Works	Chicago	IL
78553	Tinnerman Products, Inc.	Cleveland	OH
79130	Johns-Manville Products Corp.	Chicago	IL
79136	Waldes Kohinoor Inc.	Long Island City	NY
79963	Zierick Mfg. Corporation	New Rochelle	NY
80031	Mepco/Electra	Morristown	NJ
80223	United Transformer Co.	New York	NY
80294	Bourns, Incorporated	Riverside	CA
81095	Triad Transformer Corp.	Venice	CA
81312	Winchester Electronics	Oakville	CT
81349	Military Specification or Commercial Generic Number		
81603	Raco Products Co.	Chicago	IL
82104	Standard Grigsby	Aurora	IL
82389	Switchcraft, Incorporated	Chicago	IL
82877	Rotron Manufacturing Co., Inc.	Woodstock	NY
82893	Vector Electronics Inc.	Sylmar	CA
83330	Herman H. Smith, Inc.	Brooklyn	NY
83486	Elco Tool and Screw Corp.	Rockford	IL
86684	RCA	Harrison	NJ
87034	Marco-Oak Industries	Anaheim	CA
88245	Useco Div., Litton Industries	Van Nuys	CA
90201	Mallory Capacitor Company	Indianapolis	IN
91637	Dale Electronics, Inc.	Columbus	NE
91662	Elco Corporation	Willow Grove	PA
91833	Keystone Electronics Corp.	New York	NY
92194	Alpha Wire Corporation	Elizabeth	NJ
94222	Southco, Incorporated	Lester	PA
95303	RCA	Cincinnati	OH
95987	Weckesser Company, Inc.	Chicago	IL
97525	Electronic Engineering Co.	Santa Ana	CA
98159	Rubber Teck, Incorporated	Gardena	CA
98291	Sealecto Corp.	Mamaroneck	NY
98376	Zero Mfg. Co. (West)	Burbank	CA
98978	IERC	Burbank	CA
99743	IMC	Maywood	CA
99800	Delevan Electronics Corporation	Aurora	NY

Revision J
January 5, 1982

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS, Division of Amstar Technical Products Co., Inc., warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned freight prepaid, and when examination reveals that the fault has not occurred because of misuse, abnormal conditions of operation, user modification, or attempted user repair. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS will submit an estimate for such charges before commencing repair, if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or a Return Material Authorization (RMA) number will be given. Fill in RMA No. blank on shipping label attached opposite these instructions, pack instrument carefully to prevent transportation damage, affix label to shipping container, and ship freight prepaid to the factory. CALIFORNIA INSTRUMENTS shall not be responsible for repair of damage due to improper handling or packing. Instruments returned without RMA No., or freight collect will be refused. Instruments repaired under Warranty will be returned by prepaid surface freight. Instruments repaired outside the Warranty period will be returned freight collect, F.O.B. CALIFORNIA INSTRUMENTS, San Diego, CA. If requested, an estimate of repair charges will be made before work begins on repairs not covered by the Warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed immediately with the carrier. A full report of the damage should be obtained by the claim agent, and a copy of this report should be forwarded to us. CALIFORNIA INSTRUMENTS will prepare an estimate of repair cost, and repair the instrument when authorized by the claim agent. Please include model number and serial number when referring to the instrument.

From

California Instruments

A Division of Amstar Technical Products Company, Inc.

5150 Convoy Street
San Diego, California 92111

Attn: Customer Service

RMA NO. _____

MP MASTER
MA28017